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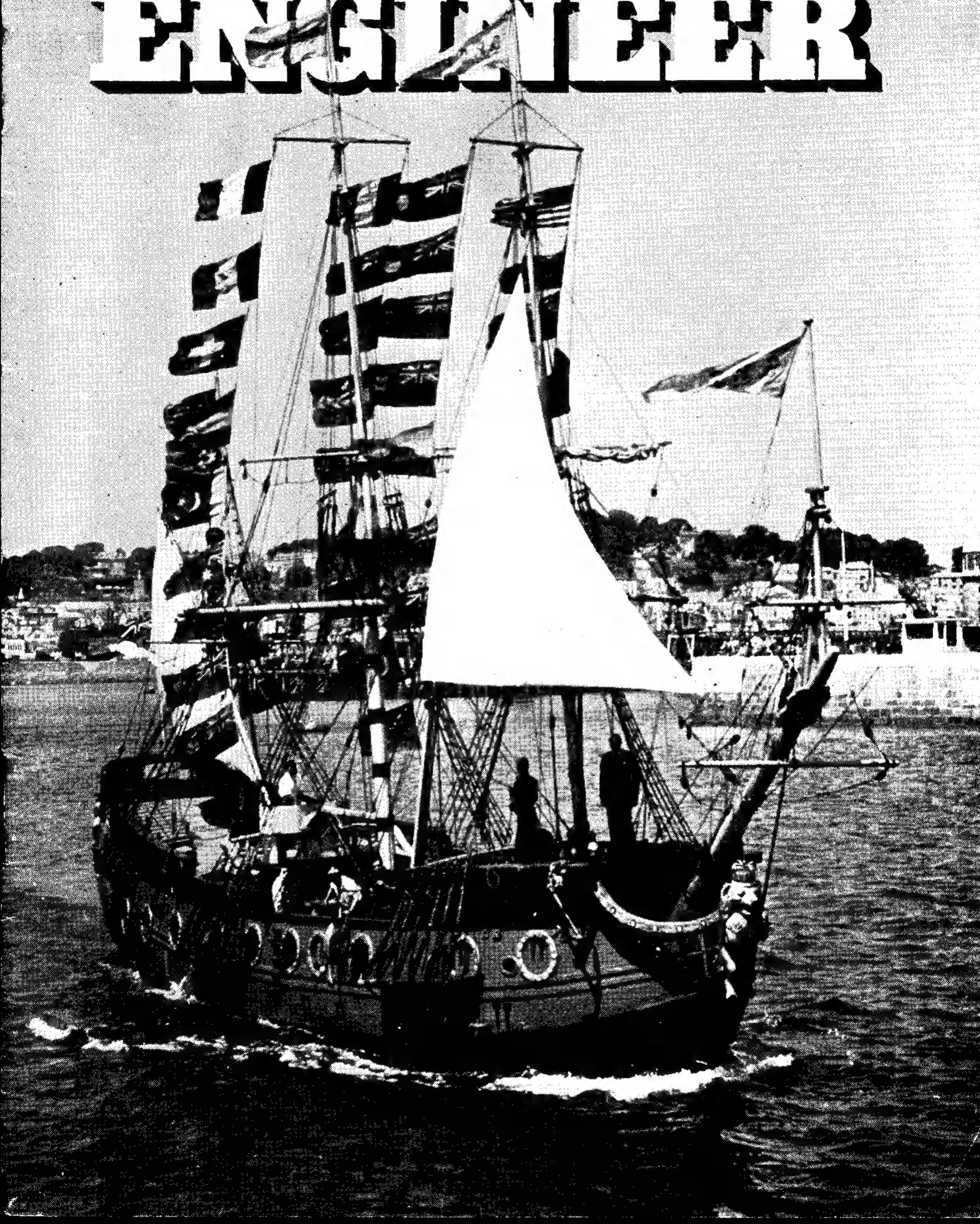
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

21ST AUGUST 1952 VOL. 107 NO. 2674

SMOKE RINGS

"M.E." Exhibition Entry Forms

● THERE IS just a further reminder of dates in connection with the MODEL ENGINEER Exhibition. First, the show will be held at the New Horticultural Hall, Greycoat Street, Westminster, London, S.W.1., from Monday, October 20th until Wednesday, October 29th.

Secondly, the final date for the receipt of completed entry-forms is Monday, September 1st. If any potential competitor has not yet completed and returned his entry-form, he is advised to do so without delay.

The Coventry Society's Track

● WE LEARN that the latest permanent passenger-carrying track to be brought into use is the one built by the Coventry Model Engineering Society in the War Memorial Park, Coventry. The society's chairman, Councillor Harry Weston, performed the official opening ceremony on June 29th.

The track is of substantial construction, built of concrete sections supported on blocks of the same material and raised only about 18 in. above ground level. Thus we have one more of these tracks, sponsored by municipal authorities, and we trust that it will meet with all success and prove to be a valuable adjunct to the town's amenities. 3½-in. and 5-in. gauges are available. The locomotive interest in the Coventry M.E.S. is very strong, as we know from our own observation, and we can well imagine that the new track will be a boon to many of the members.

To Manufacturers

● THE KENNETH Trading Corporation, P.O. Box 1721, Kowloon, Hong Kong, would like British and European manufacturers of model aircraft and railway engines, kits and supplies, to know that the Corporation is interested in importing those supplies for resale in Hong Kong. Any literature sent out would be greatly appreciated by the Corporation, and if suitable, business negotiations with respective firms might be opened. Preferably, the literature and price lists should be sent by airmail.

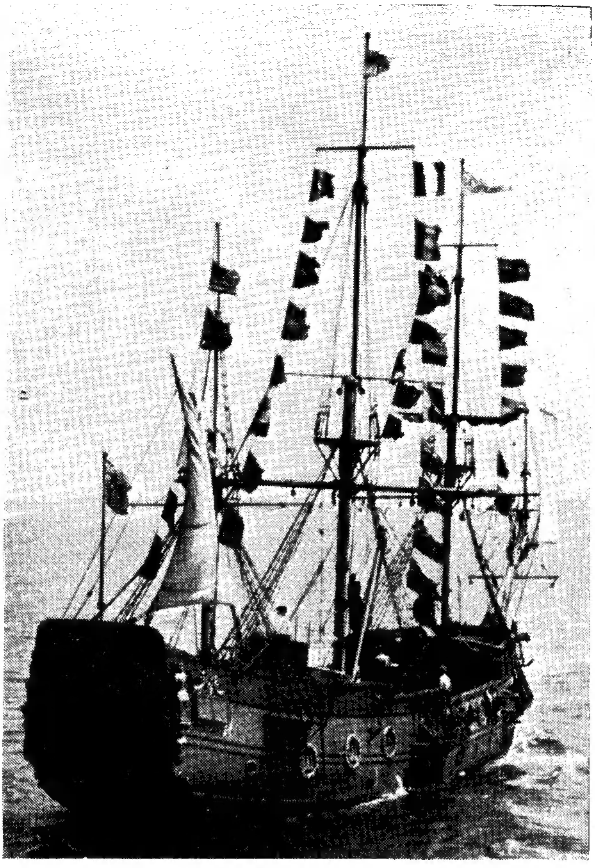
A Change of Secretary

● WE HAVE been advised that the hon. secretary of the Bath and District Society of Model and Experimental Engineers is now Mr. A. Smith, "Redtiles," Rodney Road, Saltford, Somerset, to whom all future communications should be sent. The society's meeting place is at the Y.W.C.A., 11, Laura Place, Bath.

Our Cover Picture

● FOR SEVERAL months now, the attractive ship depicted in this week's cover picture has been sailing along the coasts of the British Isles, the Channel Islands and in the estuaries of the larger rivers, causing a great deal of interest wherever she has been seen.

The ship is a half-size reproduction of the old galleon, *Centurion*, built in 1702 and used as the first ship to carry missionaries overseas. The model, if it can be so called, is ocean-going, the half-size reproduction of the original superstructure having been built on the hull of an old fishing vessel.



The two photographs, one of which is reproduced on our cover and the other on this page, were taken by Mr. A. R. Turpin, during a recent holiday in Guernsey, and show the half-size *Centurion* outward bound from the harbour there for Jersey. This picturesque vessel is used for publicising the work of the Society for the Propagation of the Gospel.

The Talyllyn Railway

● WE HAVE received a copy of the third report issued by the Talyllyn Railway Preservation Society, and we are pleased to note that, since last season, and in spite of financial difficulties, much progress has been made.

The improvement of the permanent way continues to be the committee's main preoccupation. Throughout the past winter the society's resources have been devoted almost exclusively to this end, and the staff have done excellent work under adverse conditions. The section between Towyn Wharf and Pendre stations, including the turnouts to the Pendre loop and shed road, have been relaid with main-line sleepers and Corris rail, with the addition of *ex*-Welsh Highland material for some of the turnouts. The layout at Wharf station has been remodelled by the provision of a run-round loop. Similar work on other parts of the line has been in hand in preparation for this year's season, which is to operate until September 27th.

The locomotive repairs programme has been slightly dislocated owing to the necessity for keeping No. 2 *Dolgoch* engaged upon permanent-way work throughout the winter. However, thanks to the very generous help of Mr. J. F. Alcock, managing director of the Hunslet Engine Company, Leeds, No. 4, *Edward Thomas*, has received a complete overhaul at the Leeds factory.

Individual members have made themselves responsible for such work as the overhaul and redecoration of rolling stock and station buildings. A short descriptive booklet about the railway has been prepared and, together with the set of postcards which proved so popular last year, will be on sale at Towyn during the season.

The time-table provides for two trains, morning and afternoon, each way between Towyn and Abergynolwyn, Mondays to Fridays, with an evening train each way on Wednesdays. On Saturdays, the afternoon and evening trains only are run.

Much remains to be done, and not only increasing financial help but the practical help of members is welcomed at Towyn at any time of year; more members are always wanted, and if any reader would like to join this active and thoroughly worthy enterprise, he should communicate with the hon. secretary, P. B. Whitehouse, 344, Lordswood Road, Birmingham, 17. We feel that it is impossible to overstress the fact that this attractive little railway is the last privately-owned, passenger-carrying light railway of its kind in Great Britain and, therefore, worth preservation.

Another Howler

● A SMALL boy and his father, travelling by train passing the Wath marshalling-yards, happened to catch sight of the ex-L.N.E.R. 4-8-8-2 Beyer-Garratt banking engine, which is now numbered 69999. The small boy immediately shouted: "Look, dad, they've got one of the nines upside-down"!

MODELLING ESSEX WAGONS

by Cecil A. Hewett

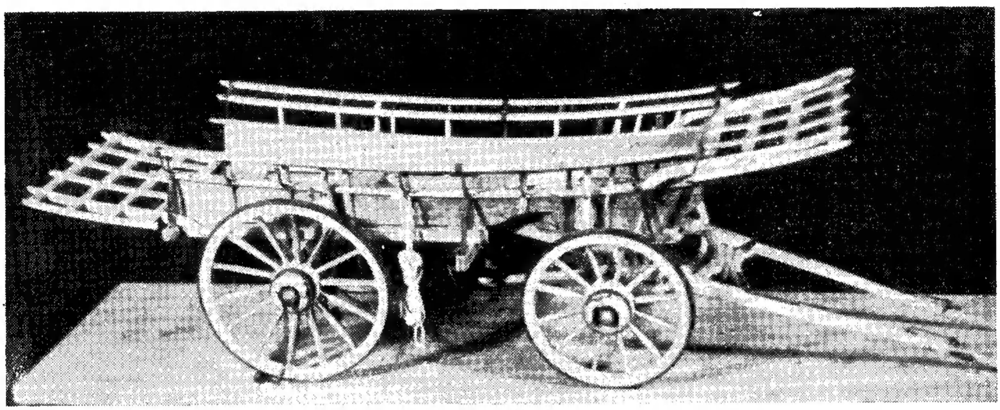
THE heyday of the wheelwrights craft in England is generally regarded as the first half of the nineteenth century, and in the majority of the Home Counties this appears to be very true. The two wagons with which this article is concerned, are in themselves very good evidence in support of the theory. The first is a half-lock, wooden-armed wagon, probably built towards the close of those " heyday " years, and the second, a quarter-lock iron-armed wagon was probably built about the year 1870.

The wooden-arm wagon was found at Sandon in central Essex, in the summer of 1941 ; where it was serving its last days as a road obstruction for invasion-defence purposes. The second still exists, utterly unvalued, at a farm in the south of Essex.

These two specimens illustrate the complexities of wagon locking, one of the wheelwright's major problems, very well indeed. The factors which had to be considered in achieving the lock of a wagon were, in most cases, invariable, if maximum strength and efficiency were to be attained.

The track, or grasp of the wagon, or for that matter any horse-drawn vehicle, was determined probably as early in history as the wheel itself was perfected ; and the greatest efficiency was attained in nearly all cases in Essex by a track dimension of fifty-one inches. The height of the front wheels was subject to circumstantial discipline, the height of the horses, the minimum locking necessary and the depth needed below the wagon bed to accommodate the transoms. The solution that satisfied all these requirements, was a front wheel of about four feet two inches in height, at which size it could not only be built to adequate strength, but would also carry its axle sufficiently clear of the ground in either rough or soft going. This last was a consideration that definitely established the minimum size of the wheel, in relation to local soil conditions.

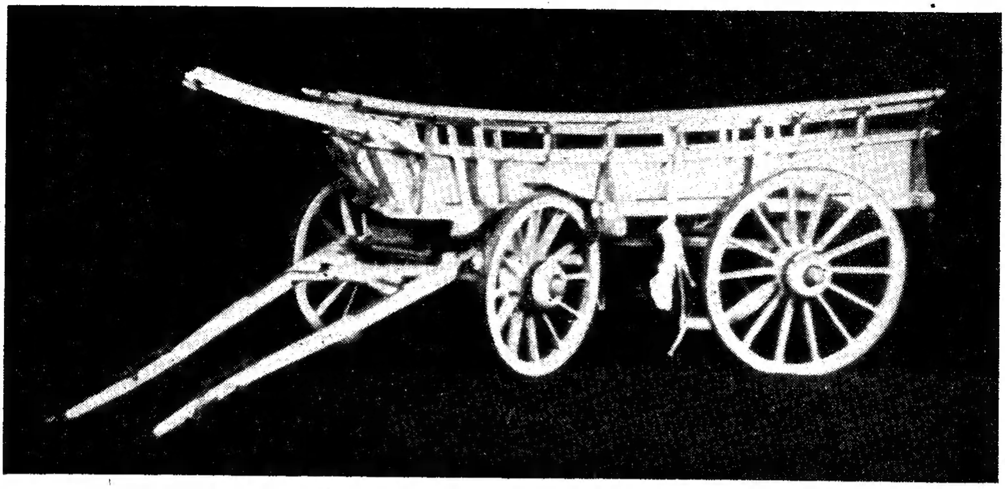
The height of the wagon body was determined by the stability required when loaded, and by the height to which the harvester could conveniently " pitch-up " the sheaves. The necessity of observing the functional values of these two heights, that of the front-wheels and that of the out-raves, resulted in the complication that the head of the wagon floor, or bed, must lie between the " tops " of the front wheels, and to this problem only two effective solutions were found ; these were the " pinched-in waist," and the wheel-arch, or locking-box.



The model wooden-arm wagon, showing locking arch

The wooden-arm wagon illustrated, has half-locking by means of these locking-boxes ; and the high front wheels can be turned to an angle of quite forty-five degrees to the central-line of the body. The other wagon illustrated has an unbroken line on the plan view of its sides, and is, therefore, technically of the three-quarter lock type ; but despite this name it can be locked to the same degree, by virtue of its having a pinched-in waist, and a very slight reduction in the height of the front wheels.

The nicety with which these two methods of wagon framing meet the demands of the locking problem, is emphasised by the fact that any greater degree of lock than is afforded by these methods, would have endangered the stability of the wagon when loaded, in view of the ever uneven surfaces it was destined to traverse, and the direct sidewise pulls which the horses could have applied to the fore carriage. It should be noted that the sides of the half-lock wagon are not actually cut, in order to accommodate the locked wheels, but are cranked to run parallel with its rim ; they are then bolted to the summers,

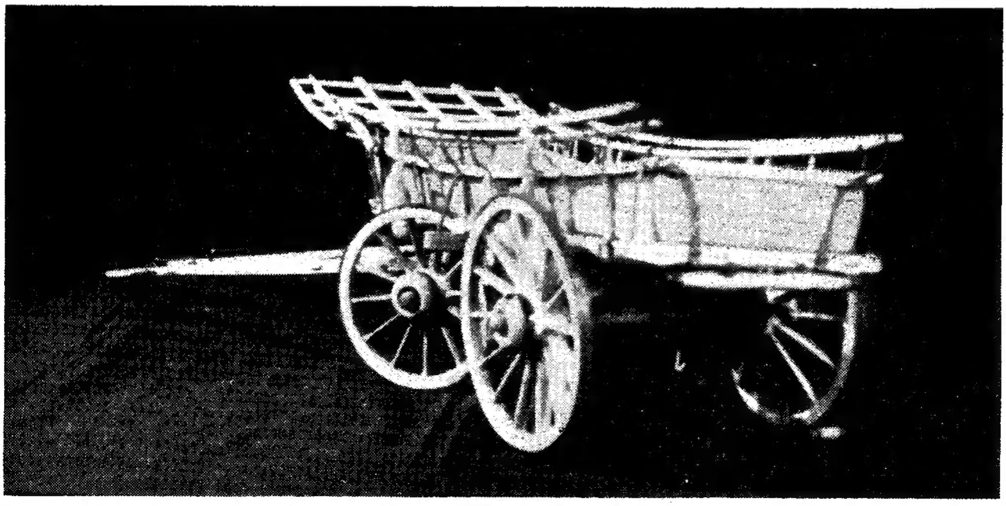


The model wooden-arm wagon, C—1850

the two heavy internal timbers of the bed, which can be seen in the front view photograph of the model, running fore and aft. In the structural strength of the two wagon bodies, therefore, there is little or no disparity.

The wagon wheels, one of the most perfect pieces of functional design ever achieved by man, in any material, or for any purpose, can without compromise, be built to any reasonable scale. It is absolutely necessary, however, not only for proper accuracy, but also to render this object possible, to adhere strictly to the use of the correct timbers for their various components. These are elm, cross-cut from the round in order to obtain the necessary radial and concentric strength, for the stocks or naves. Cleft oak for the spokes, cleft in order to ensure full longitudinal strength, and ash for the felloes, the segments with which the rims are built.

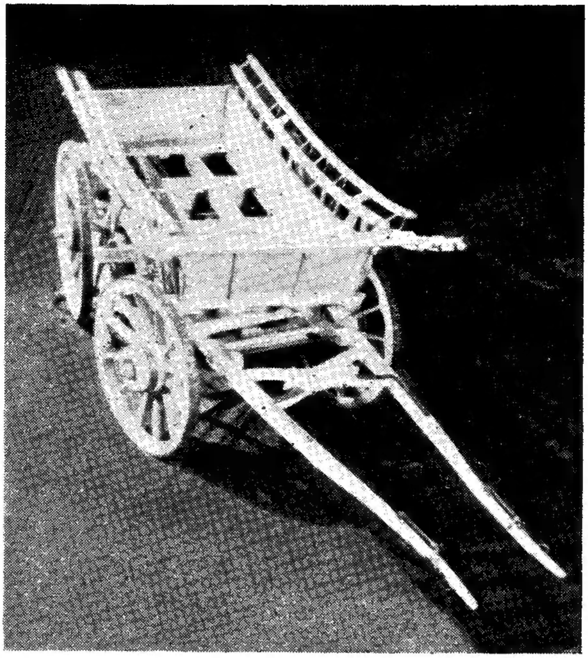
The operation of building a wheel, is, very broadly speaking, straight mortise and tenon work; but this is subject to both the radial nature of the spokes, and the "dish" of the wheel. The number of spokes, usually twelve to a front and fourteen to hind wheel, was, as in all wagon building matters, determined by regard for the material and its function. The number of spokes to a wheel of any accepted diameter was subject to the length of felloe between two spokes that could support one quarter of the wagon load, and the fact that in every other interstice that stress must come upon the dowelled and butted ends of two felloes. This was further complicated by the desirability of keeping the felloes as long as possible in relation to the circumference of the wheel, in



Showing the main beam, lock and hind shutlock

order to minimise joints in the rim. This last, was of greatest importance in the strake-shod wheels of the 1860's. which were not braced by the strakes as were the later hoop-tyred wheels by their continuous iron tyre.

It can be seen in the photographs of the iron-arm wagon that the feet of the spokes do not run in one hundred-and-eighty degree plane around the stocks of the wheels, but are set "off-and-on," the breast-stroke—the line from which the mortises were marked out. This not only gives the wheel the mean strength of both an acute and a slight "dish," but also gives its builder another point to watch when cutting the mortises for the feet and tongues of the spokes around the stocks and felloes.



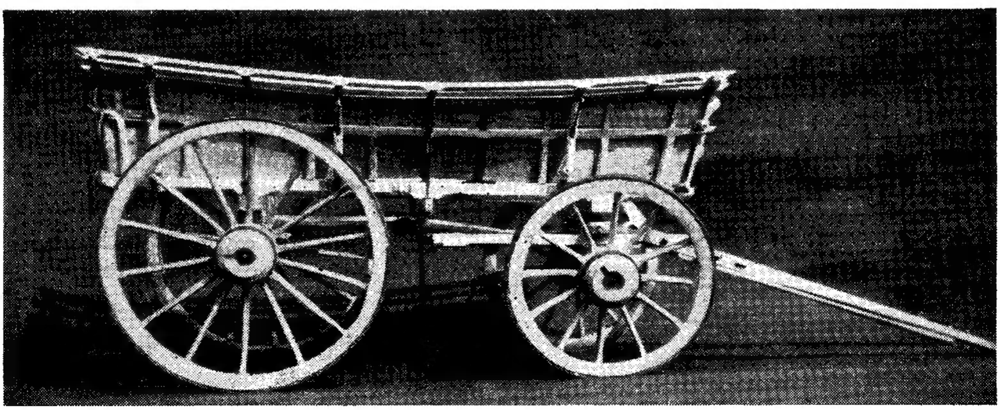
Showing the summers and locking boxes, also head and strakes

An interesting historic point that the two models illustrate, with regard to the practice of building wheels, is that both have square-tongued spokes. This seems to indicate in Essex the practice of strake-shoeing wheels for some twenty-five years after economy had enforced the adoption of iron arms.

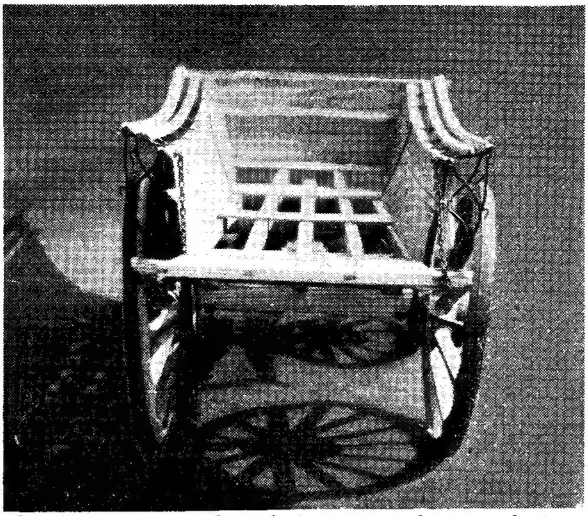
Strakes were lengths of iron, equal in length to one of the ash felloes of the rim, and were applied red-hot to the felloes, so as to brake half-way over the joints. They were secured at each end by a number (usually five) of heavy cross-pointed nails, and cooled with water, as in the latter practice of hoop-tyring. I cannot recommend to the model maker any attempt to carry out this red-hot application of either, since I have found it virtually impossible and can see no justification for such fanatical extremes of accuracy when working to eighth scale, as was the case in both models illustrated.

The wooden axles, or exes (possibly Saxon) as the wheelwright called them, were a feature of the finest craftsmanship, and are strong evidence for the ability of any craft, backed by a long tradition, to solve any problem in its own medium. They, in common with all the many parts of a wagon had to be cut carefully, and with continual regard to many angles.

First, in order that the "dished" wheels might stand with their "downward" spoke, upright beneath the load, they had to point slightly downward. But since for utmost efficiency, and to render the sidewise movement of the wheels easy, the arms were conoid and usually tapered from five-and-a-half inches to three-and-a-half or four inches at the lynch, this really meant cutting a true cone about an axis that was nowise in line with the length of



Showing all the relevant details of the model iron-arm wagon. C.—1870



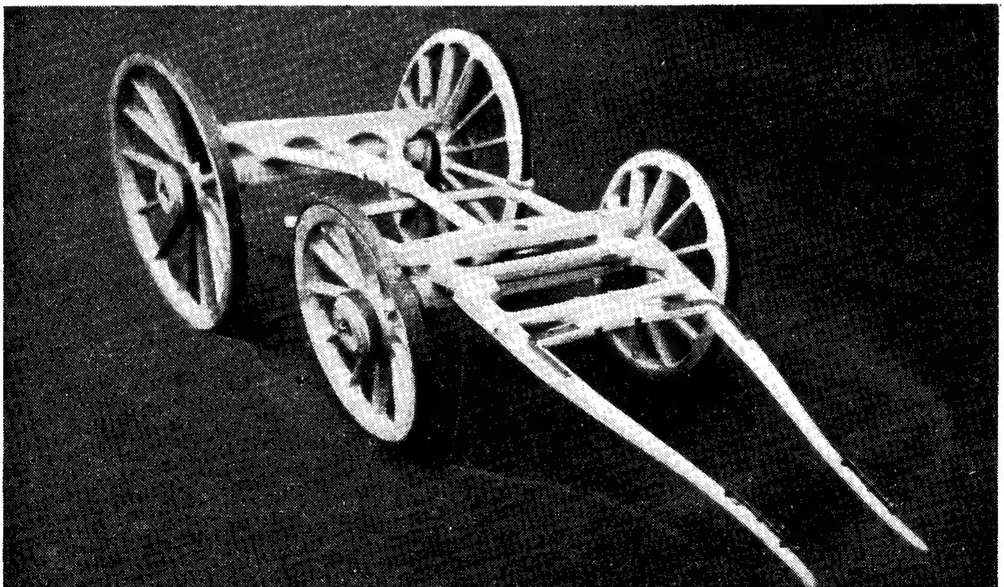
Showing summers and pinched-in waist, also wrought iron-work on sides

the ex between the wheels. This was effected by keeping the lower face of the ex plane and true, and removing all the necessary wood from its other three surfaces.

The arms also had to point a little forward in order that the wheels might track correctly, and that they might run themselves in along the arm as far as the head-irons, to meet the outward thrusts of the load and the wagon body, as it responded to the angular pulls of the horses' hind legs. This last consideration was the mysterious reason for the building of the "dished" wheels in the first place, for in a dished wheel these outward thrusts are delivered radially against the inside curves or "bosoms" of the felloes, which are unable to dilate within the immense grip of the shrunk-on strakes or tyres. Had the wheels been built in a flat plane, they must have been pushed inside out like an umbrella in a very short time.

In the case of iron-arms, these last mentioned angles which secured the "camber" and "fore-way," or "tow-in" of the wheels, are adjusted when the iron arms are set into the ex-bed.

It will be noticed upon examination of a wagon, that the undercarriage is not connected with the body, and furthermore is in two separate entities—a fore and a hind carriage. These two carriages could, when coupled by the round pin of the wagon, as shown in the photograph of the 1870 model, be used as a timber tray, or carriage. When the wagon body was in position it was only secured by this round pin, or main bolt as it was sometimes called, a massive three-inch iron bolt of some three feet in length which passed through the transoms, and the front ex or ex-bed, impaling as it went the head of the perch. This perch being the member that connects the hind ex and pillow to fore carriage, the round pin therefore, with typical wheelwrights economy of means, secures the wagon body,

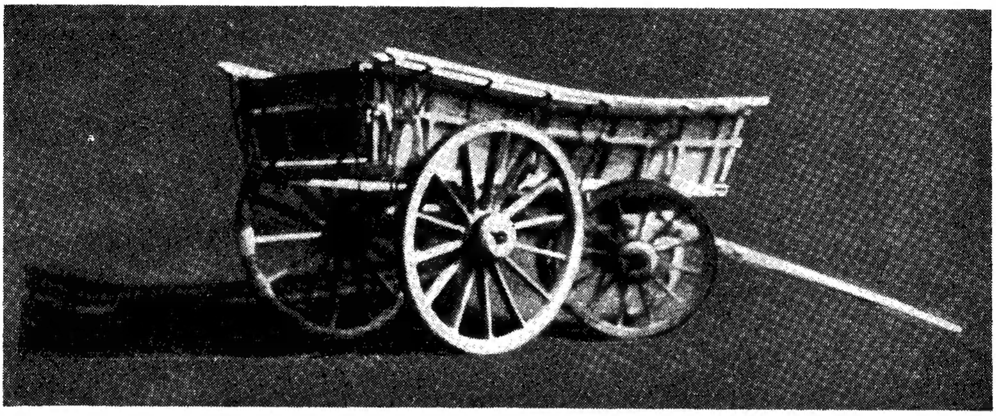


Showing undercarriage complete, and as used for timber carriage

connects the two under carriages and forms the locking pivot of the wagon.

The object of this arrangement was that all the longitudinal stresses derived from hitching the horses to the front of the wagon, were communicated directly to the hind carriage *via* the perch, without ever passing through the wagon bed, the entire strength of which was reserved for its proper purpose—the weight of the load. The main sides of the wagon merely rest on the since the raves, in cross-section are rhomboid rather than square, because the sides of the body lean outward. Also, on side elevation, the angle of the standards increases toward each extremity of the wagon.

At this stage the sides are buttressed against outward stresses of the load by the application of the strouters, the curved members that can be seen along the sides of both wagons, at the critical intervals of their length. The strouters



Showing lock, camber and construction of sides

hind pillow, and are registered against sidewise movement by the hind-irons which can clearly be seen in the photograph of the 1870 undercarriage.

The hounds, to which the shafts were attached, by means of the transverse draught pin, project rearward of the front ex and transom, between which they are bolted and rebated, and carry at their rear ends a metalled sweep which slides against the under side of the perch. This device prevented any tendency of the fore carriage to "fold under" the wagon, as it might otherwise have done, when a front wheel mounted any obstruction under a heavy load. The perch has the same control over the hind carriage, and in the older wooden arm wagon is continued rearward as far as the hind shutlock, the better to serve this purpose.

The wagon body is built up from the bed, which comprises the sides and summers, the fore and hind shutlocks at their respective ends of these, and the main beam, which passes under the whole at a point immediately behind the locking cletes, or arches, as in the older wagon. The top transom is also bolted up to the bed timbers, and contributes much to the strength of a wagon-bed into which the locking boxes penetrate far inward. The sides of the body are formed by the running pins or standards, which are tenoned into the sides, and for the head, into the front shutlock. The upper halves of these form long tenons which run right through the middle raves, which are knocked down to their shoulders, and on to the tops of which are mortised the top raves. Here again the difficulty is to observe correctly all the angles involved; convert the outward leverage of the load on the raves, into inward pressure on the sides. The out raves are carried well over the sides by iron copses and ravestays, which carry the pressure on them down to the level of the middle raves. In the iron-arm wagon, the ravestays are carried where possible to the strouters, which can be seen in the model, on three-quarter view.

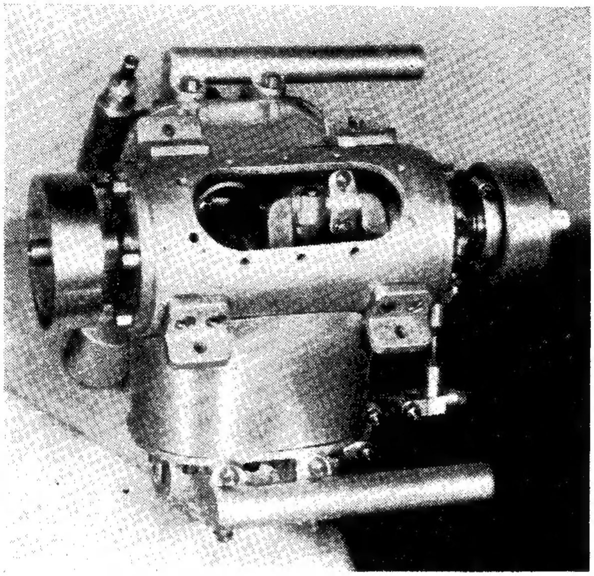
The two models illustrated and described, are built throughout by the correct joinery, and in the timbers used for their prototypes; the model of the older wagon is now in the possession of the Science Museum, where, it is to be hoped, it will be joined by many other records of the supreme beauty achieved in the cause of the wagon's utilitarian tradition. For from the near London Counties, the Harvest Wain, that has for so many centuries been an essential part of the pattern of English life and craftsmanship, has almost passed out of existence.

The finding of old wagons and tumbrils that reflect the perfection of workmanship and design that were the acknowledged standards of the nineteenth century rural Englishman, has already become a work demanding considerable patience and research. Little has yet been done to furnish a complete record of the history and end of this great national craft, and accurate models are perhaps the best way of creating one. I would apologise for the use of an esoteric terminology, but this has been unavoidable, and I would recommend to any whose curiosity it has aroused, two books which elucidate all the theory and nomenclature of the subject. These are: *A History of Everyday Things in England*, Quennel, and *The Wheelwright's Shop*, Sturt.

A FOUR-CYLINDER "VEE" TYPE MARINE ENGINE

by Warren W. Lacy, Jr., M.D. (New York)

THE pattern for the cylinder blocks consisted of two cylinders, merged slightly at their line of contact, a plain upper flange and a curved lower flange glued together, with proper wax fillets. On final erection, sheet aluminium lagging was placed around the blocks, in streamline fashion.



Engine inverted with crankpan removed

The castings were fixed to a boring table on the cross slide of the saddle. The first cylinder was bored with a fly-cutter and a bar held between centres. The cross slide was then advanced under control of the metric collar the exact distance between cylinder centres, and the other cylinder bored in like manner. After boring both cylinders and inserting steel liner sleeves, the table was rotated 90 deg., and a fly-cutter in a bar held between centres was used to mill the concave seat of the cylinder block to the radius required for apposition to the crankcase barrel. This set-up ensured:

(a) Parallelism of both cylinders.
(b) Accurate distance between cylinder centres.
(c) Squareness of cylinders with crankshaft when erected.
(d) That centre line of cylinders intersected centre of rotation of crankshaft when erected.

The table was then rotated another 90 deg. and the upper surface of the block milled flat with a cutter held in the headstock spindle.

The lap used for finishing the cylinder bores was a split brass collar carried on a tapered arbor. By positioning the brass on the taper, a limited adjustment in size could be made. All tool marks were erased with medium carborundum. Finishing was done with a fine abrasive until a polish was obtained. The final fitting of the blocks to the crankcase was carried out by lapping these two components to one another, and permanently screwing them together with shellac on the inter-face.

Crankshaft

The crankshaft was cut from solid. Work was laid out on a bar of sufficient proportions, and centre holes were drilled on both ends. Prior to machining, much of the unwanted metal was drilled and hack-sawed away. Both throws were machined between centres and all tool marks removed with very fine garnet paper at high speed. The shaft extensions were then finished in the same manner. The crankpins and shaft extensions were then drilled out to reduce weight. This is especially effective in the case of the crankpins, since any saving is accompanied by a proportionate saving in necessary counterweight. Gummed paper was wound around the bearing surfaces for protection while working on the webs. These were rough-filed to contours shown in the drawings, and finally polished with carborundum cloth.

Connecting-rods

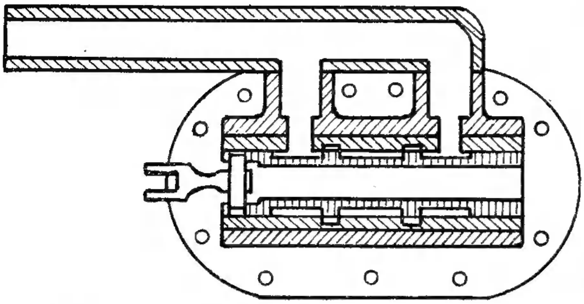
The connecting-rods were cast in duralumin of " I " beam section, with the crankpin straps all in one piece. Retaining screw-holes were drilled, and the caps parted off. Caps were screwed to the rods proper, and marked for future assembly. The rods were then held in a jig on the lathe saddle for drilling and reaming of crankpin and wristpin holes at one setting. In this way, the two holes were held parallel in both planes, and the distance between the holes was measurable by the metric collar on the cross-feed.

The side facing on the rods was then carried out on stub mandrels. A short piece of round stock was chucked and turned to size. It was not removed from the chuck until all work to be done was completed. The mandrel for the wristpin was drilled and tapped with tools held in the tailstock chuck. It was then split. Tightening of a screw in the tapped hole expanded the mandrel within the wristpin hole of the connecting-rod

Continued from page 218, " *M.E.*," *August* 14, 1952.

to hold it securely. The stub mandrel for the crankpin hole was simply a rod turned slightly oversize. The connecting-rod was secured to the mandrel by tightening the bearing cap retaining screws.

The crankpin ends of the connecting-rods were lapped to the crankpins with fine abrasive and finally fitted by honing the bearing caps on a flat stone. The unmachined surfaces were cleaned up with a fine file and carborundum cloth.



Section through piston-valve and exhaust pipe

Pistons

Pistons were cast from automobile piston metal, with a vented green sand core bearing imprints of the wristpin bosses. Adequate lug extension was left for chucking. The castings were held in the four-jaw chuck by those lugs, and set so that the cored hole ran true. A roughing cut was taken over the outside. The work was then reversed, and held in the three-jaw chuck while a turning cut was made over the lug. A crotch centre was placed in the headstock spindle and the piston clamped crosswise against it. In this position the wristpin hole was drilled. A small internal grooving tool was then inserted to face both internal bosses, after which the pinhole was finish reamed. An external finish-turning cut and lapping brought the pistons to size.

Wristpins

Steel rod was brought to near finished size by turning. The pins were polished with fine garnet paper to a stiff push fit in the pistons. The pins were then drilled out hollow. Since the pins are floating, soft aluminium pads were driven into each end to prevent the cylinder scoring in operation. The wristpin eyes of the connecting-rods were lapped lightly with fine abrasive to produce a running fit on the wristpins.

Rings

Piston rings were turned from cast-iron stick. The external size was first turned on the bar, then a slight set-over was made and the internal diameter bored. After the rings were parted off, they were sawed through the thinnest part of the circumference, so as to produce a ring tapering in thickness toward the gap. Such a ring compresses more as a perfect circle than rings of uniform thickness. The top and bottom surfaces were honed on a flat oil-stone to groove width. The final lapping of the friction face was carried out on a special jig designed to clamp the rings in the same degree of compression to which they are subject in the cylinders. To accomplish this, the ring was pushed into the cylinder. The jig was clamped on to the ring, and the whole issue then withdrawn from the cylinder. A proper gap was provided by filing.

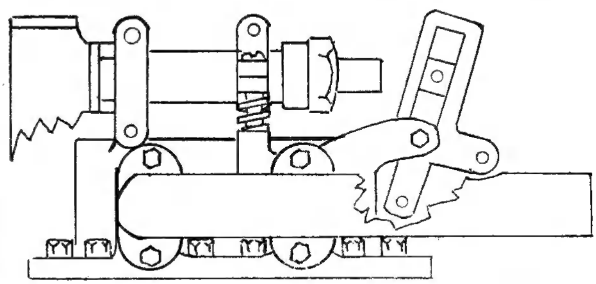
Pistons and piston valves were originally fitted quite snugly. They operated perfectly on air, but would stick fast under steam due to expansion of the aluminium in excess of the steel liners. To correct this, the pistons were lapped into the cylinder by hand with polishing abrasive, until just free when heated in boiling water. Advantage was taken of this necessary step by securing further lapping of the rings which were left in place during the operation. This resulted in a high polish over the entire friction face of the rings.

Eccentrics

The eccentrics are aluminium, with steel tyres shrunk on. They were machined from one piece of solid aluminium. Bar stock was notched on each side to receive opposing jaws of the four-jaw chuck. After turning the first eccentric, the jaw adjusting screws were moved sufficiently to set over the required eccentricity and the shaft hole was drilled and reamed. The work was again shifted the same distance in the same direction, and the opposite eccentric turned.

Valves

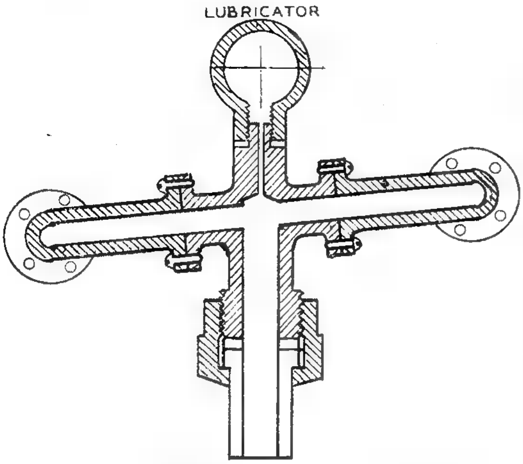
The aluminium cylinder-head is steel sleeved to receive the piston valves. The sleeves are of generous thickness to allow for turning of internal grooves for the cylinder ports. The ports themselves are slot-like, narrow to hold down total valve length, but broad to maintain cross-sectional area. The short straight simple porting is reflected in rapid acceleration and high top speed. At the same time, dead space is held to a minimum.



Elevation of port cylinder-head with boiler feed pump mounted on top

The valve pistons are simple spindles of cast automobile piston metal. They are of generous

diameter to provide over their circumferential lip a broad port opening. The depth of the steam and exhaust grooves are such as to avoid any narrowing tendency in the properly increasing pathway of steam in its expansion from feed to exhaust. Since the groove depth required but a



Section through steam pipes and lubricator

fraction of the piston diameter, it was possible to lighten the reciprocating mass by drilling out the central portion.

Timing

In finding dead centres on this engine, advantage was taken of the fact that when the starboard side is on dead centre, the port side is at 90 degrees to dead centre. With the cylinder-heads off and pistons and connecting-rods out, but with crankshaft in place, the latter was set to as close to dead centre for the starboard side as possible, by eye. Measurements were then taken from the milled top surface of the port cylinder block. Using this surface as reference, the distance downward through the port side cylinders was measured to each of the two crankpins in turn. The shaft was adjusted rotationally until both pins were equidistant from this reference surface. The shaft was then 90 degrees to dead centre for the port side cylinders, and on exact dead centre for the starboard cylinders. The forward flywheel had already received quartering marks on the circumference. An indicator was then bolted to the forward crankcase cover plate and adjusted to register with one of the quartering marks.

The eccentrics were adjusted to 90 degrees with the crankshaft by similar measurements from the upper surface of the starboard cylinder block. The eccentrics were advanced slightly from this setting and secured.

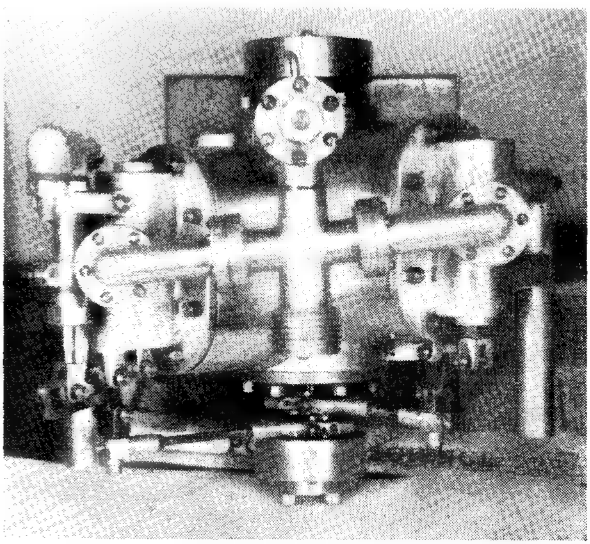
The heads were then put in place, leaving the piston and connecting-rods out of the engine.

The valve spindles had already been turned, leaving plenty of lap, also the chucking lug intact. The eccentric rods were then adjusted in length to centre the valve spindles in the valve cylinders. The steam grooves were widened, by the cut and try method, until admission began at top dead centre, and the exhaust grooves widened until exhaust began at bottom dead centre. This was checked by noting escape of testing air in relation to flywheel and indicator previously referred to. The exhaust was cut off at approximately 7/8 stroke, and an associated 1/8 stroke compression.

Final Cleaning

Prior to final assembly, all parts were scrubbed in kerosene, followed by hot soapy water, in an effort to remove all traces of abrasive. Pipe cleaners were quite useful for getting into small holes. As a further precaution, a bath in carbon tetrachloride was provided. As erection proceeded, all parts received a liberal dose of No. 10 motor oil. The engine was then broken in on air at slow speed. After a two hour run, the motor was torn down, inspected, and rescrubbed in kerosene. Evidence was found of very fine particles of metal in the crankcase.

The engine will start instantly on moderate pressure, and can be throttled until just ticking over. Its turning effort is smooth and effortless, and the starting torque quite strong. Due to the care taken in balancing, it is practically vibration-free. On idling, the only sound is a quiet purr of the exhaust. Under load at moderate speed, the exhaust occurs in staccato cadence. At increasing speed the individual beats blend into a single note of rising pitch.



View from above, showing steam pipe connections

Making a Workshop Camera

by
" Dioptre "

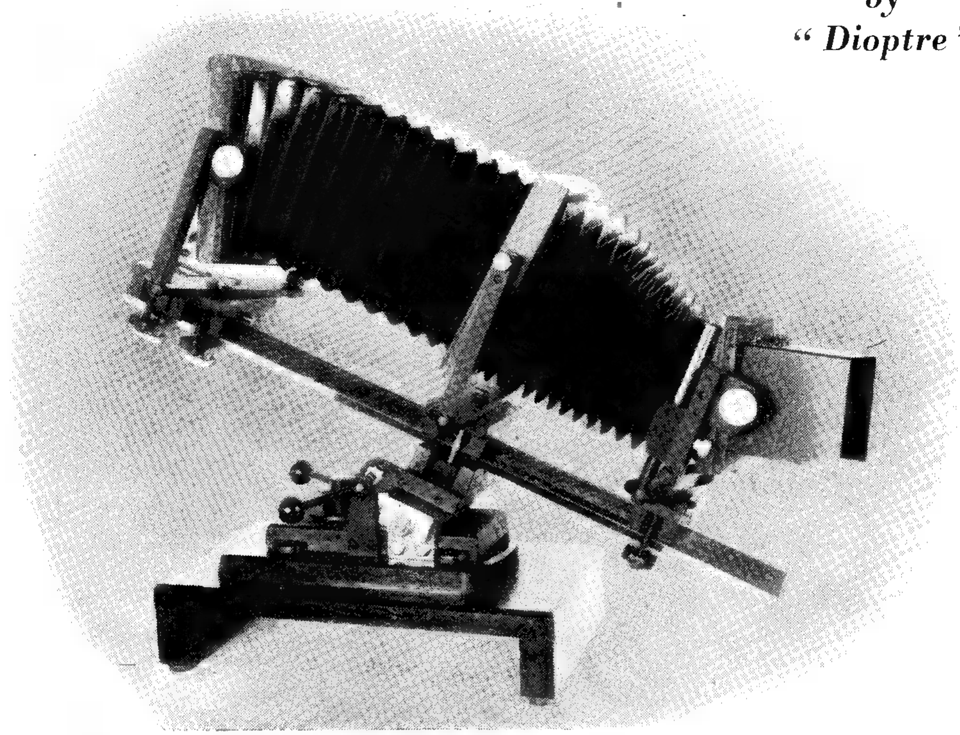


Fig. 1. *The camera bed inclined : the front swung, tilted and moved across : the back tilted and swung*

CAMERAS of the kind described are commonly known as technical cameras and are used in laboratories mostly for photographing small objects resting on the bench. The commercial patterns available are extremely expensive, largely perhaps because they are made to fold into a small compass and are of light construction as an aid to portability. The camera described is, however, not intended for carrying about, and is heavily and robustly constructed to promote stability. All the usual camera movements have been incorporated, as these add but little complication to the design, and to satisfy all requirements it is better to have too many rather than too few.

A rigid, square-section bar bed is used, and this has its diagonal set vertically in order to give good guidance for the V-bases of the sliding members. In this way, the use of keys for locating the slides is avoided, for a key placed not far from the centre of the bar bed cannot be relied on to afford proper guidance after the inevitable wear has taken place.

The pivoted movements of the camera are not locked by means of pivot clamp-screws, as this again is not a very reliable method ; instead, slotted quadrants are fitted to afford a secure hold with only light tightening of the quadrant clamp-screw. The camera front has a rise and fall movement, independent of the lens panel and furnished with metal sliding members ; in addition, the front can be swung, tilted, and moved crosswise. The camera back is fitted with swing and tilt movements only, and these should be found sufficient for all ordinary work.

A rising and falling front is necessary in hand cameras where a tilting back is not fitted, but it is realised, of course, that the same effect can be obtained in a stand camera by tilting the camera as a whole and then setting both the back and the front upright, as for photographing tall, perpendicular objects such as architectural subjects. The square-section bar bed is carried in a tilting bracket, locked by means of a quadrant and clamp-screw and, in addition, the bed can be moved endwise, either as an alternative way of bringing the lens nearer to the object or to set the point of balance of the camera directly over the pivot. The length of the bar bed used will, of course, depend on the focal

length of the lens fitted and on the required degree of magnification of the object ; in the present instance, a bed length of 24 in. has been adopted in order to obtain a magnification of 3 to 1 with a lens of 6 in. focal length, or a ratio of 2 to 1 with an 8-in. lens.

For aligning the camera in the horizontal plane, the wooden sole attached to the cast-iron bedplate is made to pivot on the large wooden base on which the camera stands. The vertical setting is made by tilting the bracket in which the bar bed is carried.

As the bellows are of considerable length, to give the necessary extension for close-up work, they are made in two sections and are supported by a central frame to prevent sagging. The forward portion of the bellows is made tapered, but the rear section has parallel sides to enable full use to be made of the camera movements, and also to prevent the reflection of light from the interior.

A spring-controlled, pivoted lens hood is fitted and remains attached to the camera front, but it can readily be turned aside to allow the lens to be changed or the iris diaphragm to be adjusted. Although a lens cap can quite well be manipulated within the lens hood, a simple form of spring-controlled capping shutter has been added and is operated by means of a finger lever. This arrangement has the advantage that the lens hood cannot be brought into place unless the lens shutter is closed ; this may, on occasion, save leaving the lens inadvertently uncapped before the actual exposure is made.

It is hardly worth while making a revolving back, like that fitted to some reflex cameras, and the changing of the viewing screen and the dark slide from the vertical to the horizontal position is easily effected by using a back attachment of square form, made to fit either way up in the camera back—the so-called reversible back. In this connection, the back attachment is best made so that it will fit any other camera in use of the same plate size and, in this way, the same set of dark slides can be used in several cameras.

Although it is not difficult to make dark slides, it will save trouble and ensure satisfactory working if standard dark slides are employed. Good-quality metal slides will be found to work freely and are probably less liable to develop light leaks than some types of wooden dark slides which may swell when damp and cause the shutters to stick. With the present camera, a set of double slides belonging to an Adams reflex camera is used, and these also fit the reversible back made for another stand camera. Slides of this pattern are very easy to load by touch alone in the changing bag, and the thin, sheet aluminium, removable sliding shutters always work freely and are well light-trapped.

Focussing

Those who have taken close-up views of small objects will have found that, when focussing by racking the camera front, it is at times impossible to arrive at a correct focus of the image on the screen ; for as the lens is moved away from the plate, so the lens is brought nearer to the object. When this happens, the usual way of focussing is to move the camera bodily backwards and forwards until the right position is found.

In cameras fitted with triple extension, the camera back, as well as the front, can be moved by means of the rack and pinion gear, so that when focussing near objects the distance between the lens and the object can remain fixed and the focussing screen alone is moved in relation to the lens. With the workshop camera, the front is first set to give approximately the extension required, and the back is then slid on the bed trombone-fashion—and it moves very easily and smoothly—until the object appears to be in focus.

For the final exact focussing, the back is moved to and fro by means of a lever that gives a very fine degree of adjustment ; the back is then also rigidly clamped to the bed. Focussing with a lever mechanism has been found much more satisfactory than the usual rack and pinion gear with its very small finger-wheel, its rather stiff and slow movement, and with backlash developing after wear has taken place. To make focussing still easier, the focussing cloth is attached to the back of the camera, but is made readily detachable and then serves as a covering for the camera.

During focussing it may be found that the image is not of the size required to fill the ground glass ; that is to say, the lens is either too near or too far from the object. This is easily corrected by sliding both the camera front and the back along the bed with the two hands, until the image is of the right size and the object is brought into focus. Should the camera itself have to be moved, it is easily lifted by placing a hand under either end of the bed, and the low centre of gravity will then give stability.

Plate Size

For this kind of photography, plates are generally preferred because of their ease of handling both before and after exposure. Soft-gradation panchromatic plates have been found to give good rendering of the wide range of tone values associated with small mechanical objects, for the polished steel parts will have bright high-lights while some painted areas may reflect but little light ; if, however, a plate giving greater contrast is used, the resulting negative and print may show an unpleasing black and white effect. The question of the kind of plate used has been brought up to show that a panchromatic plate is well-suited for this work, and, this being so, a changing bag may be found more convenient than working in a dark-room, where even a safe-light is not always safe for panchromatic plates. If a changing bag is used for loading the dark slides and transferring the plates to the developing tank, the size of plate that can be conveniently handled is necessarily limited, and the choice will probably rest between the $2\frac{1}{2}$ in. $\times$ $3\frac{1}{2}$ in. size and the $\frac{1}{4}$-plate.

A $\frac{1}{2}$-plate might be preferred as giving pictures of good size by contact printing and, thus, any lack of sharpness will not be increased by the need for enlargement ; but handling in the changing bag would be difficult, developing tanks of this size are not always obtainable and, in addition, the cost of plates and processing solutions would be twice that incurred when using $\frac{1}{4}$-plates. The $\frac{1}{2}$-plate print is usually regarded as the smallest

acceptable for Press work, or for that matter for showing to one's friends. Again, the ¼-plate may be preferred to the 2½ in. × 3½ in. size, as less enlargement, with a smaller loss of sharpness, is required for the final ½-plate print ; moreover, plates are generally most easily obtainable in the ¼-plate size. As a good case has been made out for the ¼-plate, this size has, not without reason, been adopted for the workshop camera.

The Lens

As reproduction of photographic prints by means of half-tone blocks results in some loss of detail and sharpness, it is essential that the prints themselves should be of really good quality, and so a high-grade anastigmat lens is best used for this kind of work. It may be said that a cheap lens will be good enough if a very small stop is used to cut down the optical errors ; the optical errors will, it is true, be reduced in this way, but even the best lens will lose some of its capacity to resolve and reproduce fine detail if stopped down more than, say, about half-way on the scale of the iris diaphragm.

The lens usually has to be stopped down to some extent to obtain the necessary depth of field required to bring the far and near parts of the object simultaneously into focus, but a smaller depth of field may suffice if full use is made of the camera movements. There is no need in this work to use a lens of very large aperture, as the length of exposure is immaterial and, in any case, some stopping down will usually be necessary.

Anastigmat lenses, having an aperture of f/6.3 to f/8 can be bought second-hand quite cheaply, as nowadays the craze is all for large apertures and high speeds. As the camera has been made to close to 6 in., a lens of 6 in. focal length will then focus all distant objects, and when the camera is fully extended to 24 in., objects can be photographed at three times their full size.

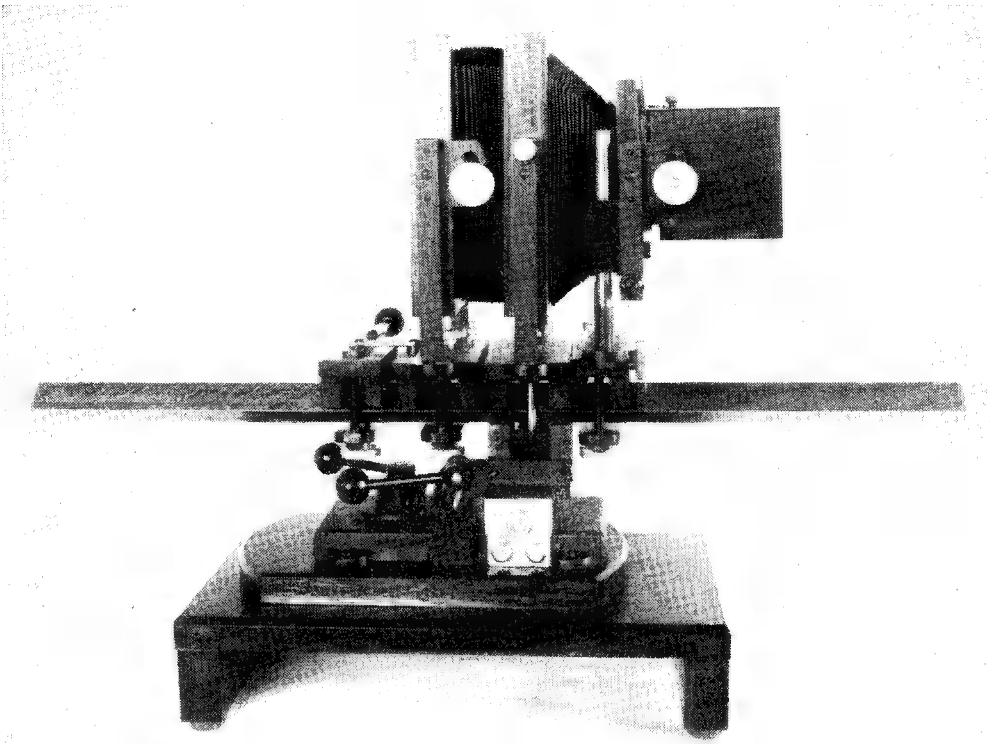


Fig. 2. The camera closed

To obtain the approximate lens to plate distance, the focal length is multiplied by the degree of magnification and the product is added to the focal length, thus :

focal length of lens = 6 in. and magnification = 3

then $6 \times 3 + 6 = 24$ in.

In the same way, the distance from the lens to the object is obtained by dividing the focal length by the magnification and adding this number to the focal length : $\frac{6}{3} + 6 = 8$ in.

It will be apparent that, when photographing an object three times full-size, the distance between the lens and the plate will be three times the distance of the lens from the object ; also, where the object is photographed exactly full-size, these two distances will be equal. For more precise working, these distances must be measured from the nodal points of the lens, but if the measurements are made from the iris diaphragm, the

Fig. 3. Rear view of the camera, showing arrangement of the back and fine-focussing mechanism

results obtained will be sufficiently exact for all ordinary purposes.

A lens of 6 in. focal length will cover a plate 5 in. × 4 in.; so when the lens is used with a ¼-plate, distortion can be corrected by raising or lowering the camera front and, at the same time, it will be possible to keep within the area covered sharply by the lens.

In workshop photography of small objects it is advisable to work with both camera and object resting on the same table or bench, for then any slight movement of the floor will not upset the relative positions of the two, and so give rise to a blurred negative.

If however, the bench space is limited, it may be necessary to fit a lens of shorter focal length for focussing objects of larger size. This also applies when photographing work set up in the lathe, where there is not room to erect the camera at the greater distance necessary with the lens of longer focal length. As the camera only closes to 6 in., a lens of 5 in. focal length will not, here, focus distant objects; but on the other hand, this lens will photograph the object at nearly four times its full size with the camera fully extended.

One disadvantage of the short-focus lens is that in close-up work the perspective is liable to be exaggerated; again, the lens will cover a smaller plate area and this restricts the use that can be made of the camera movements.

A lens of 8 in. focal length can quite well be used with the camera, but this means, of course, that the object will have to be placed farther away and possibly beyond the capacity of the bench. The lens will, however, give much greater coverage so that the camera movements can be utilised to the full.

Application of the formula previously given will show that this lens will enable the object to be photographed at twice its full size when the camera is fully extended.

To reduce the focal length of a lens for close-up work, and so save having to buy more than one lens, it is the common practice to fit ■ supplementary lens, such as a spectacle lens, to the front of the lens mount. Good photographic results can be obtained by this means, but to avoid distortion due to optical errors ■ small stop may have to be used. Nevertheless, the addition of an ordinary lens will usually impair to some extent the performance of ■ high-grade lens, and severe stopping down will also result in some loss of critical definition.

The refractive power, or focussing power, of spectacle lenses is rated in diopters, so that a 1-diopter positive lens has ■ focal length of 1 metre and ■ 2-diopter lens ■ focal length of ½ metre. In multiple stores, the focal length of these lenses is usually expressed approximately in inches, and ■ 1-diopter lens is marked 36, a 2-diopter 18, and ■ 4-diopter lens 9.

To determine the combined focal length—F—of ■ main lens—f1—to which ■ supplementary—f2—has been attached, the formula is:

$$\frac{1}{f1} + \frac{1}{f2} = \frac{1}{F}$$

For example, the focal lengths of the two lenses are 6 in. and 36 in.

then $\frac{1}{6} + \frac{1}{36} = \frac{1}{F}$

therefore, F (the combined focal length) = 5 1/7 in.

Although, as a rule, lenses of well-known make have the focal length, as well as other particulars, engraved on the mount, it may happen that an old lens of quite good quality is not marked in this way and the focal length has to be determined.

An easy and sufficiently accurate way of finding the focal length of a lens is to focus ■ distant object on the ground-glass screen, and then to mark the exact position of the camera's focussing slide. Next, the camera is refocussed on ■ near object so that the image, when measured on the focussing screen, is exactly the same size as the object. A second mark is now made on the camera slide, and the distance between the two marks will then represent the focal length of the lens.

Depth of Field

To obtain ■ satisfactory photograph, it is necessary to bring into sharp focus both the near and the far parts of small mechanical objects, and this is usually done by stopping down the lens, but the camera movements can also be employed to ■ limited extent for this purpose. The distance between the two planes brought into sharp focus is known as the depth of field,

although this is sometimes termed the depth of focus. The utilisation of the camera movements, to facilitate the focussing of near objects, will be considered later when describing the working of the finished camera.

In close-up photography, where the size of the image is adjusted so as to fill the focussing screen, the depth of field with the same size of stop will be but little affected by the actual focal length of the lens fitted to the camera.

A lens of longer focal length, however, has the advantage that it is usually more convenient to work at a rather greater distance from the object and, at the same time, in daylight photography the camera itself is then less liable to cast a shadow or to interfere with the proper lighting of the subject.

An apology must be offered to those readers already conversant with these elementary optical principles and calculations, but these are fundamentally important when it comes to building a camera, and a grasp of the subject will be helpful when alterations have to be made in the design to meet special circumstances, as, for example, where the camera is adapted to take a plate of another size.

The next instalment will, however, be on more practical lines and will deal in detail with the actual construction of the camera illustrated.

(To be continued)

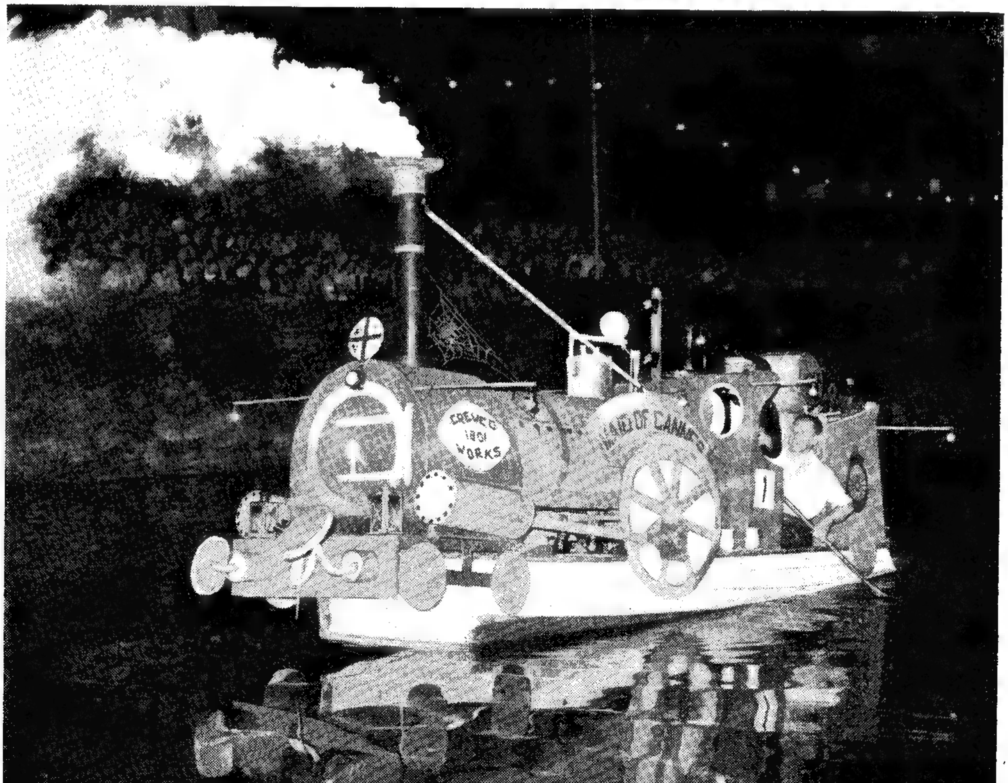
AN AMPHIBIOUS MONSTER

by J. H. Brooker

BY way of a change of activities, the Tonbridge Model Engineering Society entered a boat in the Venetian Fete held on the Medway, at Tonbridge, on a recent Saturday evening.

The entry took the form of a burlesque locomotive, with driver and fireman in stovepipe hats, chimney belching smoke, and driving wheels and connecting-rods operating realistically. It wallowed down the river at the head of the procession in fine style, and all the hours of work, and little anxieties which went to its making, were more than repaid by the applause and laughter of 20,000 spectators, which greeted its appearance.

Messrs. Austen and Portlock are to be congratulated for designing, and superintending, the making of the model, which was awarded third prize.

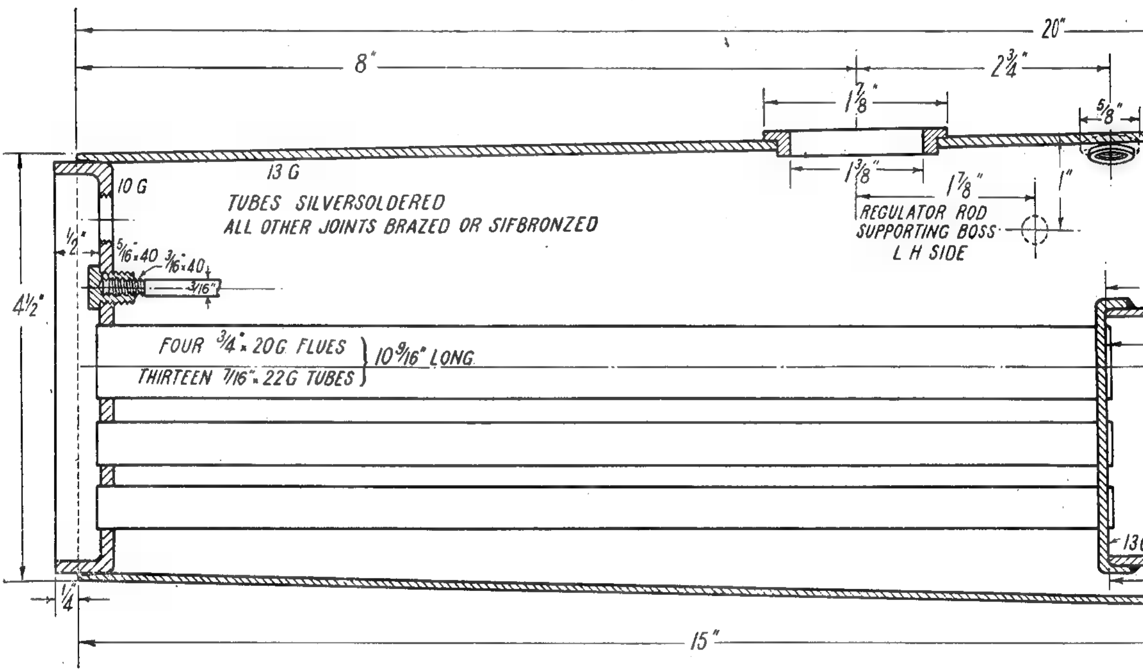


"Britannia" in $3\frac{1}{2}$-in. G

Constructing the

AT the time of writing, I haven't managed to scheme out a workable arrangement of steam-operated cylinder cocks for the $3\frac{1}{2}$-in. gauge *Britannia*, and it looks as if we shall have to use the ordinary kind, operated by a Bowden wire. It would be perfectly easy to make slavish copies "to scale," of the full-sized article, but they would be utterly useless for the little engine; for example, you couldn't maintain two feet of $\frac{1}{8}$-in. pipe full of steam while the engine was running. The steam would condense, the pipe would fill with water, and the cocks wouldn't work. However, I may hit on a solution, so we'll leave it for the time being, as the cocks can be fitted at any time. It is also not much good describing the cab reverser, as this cannot be fitted until the cab is made and erected; it is attached to a bracket on the cab side. Therefore, to save time, I will now describe the boiler.

It will be seen from the accompanying illustrations, that *Britannia's* boiler is pretty much the same as that which I described for *Pamela*, the ex-spam-can. The outer dimensions are exactly proportional to those on the full-sized engine, but the arrangement of firebox, combustion-chamber and tubes are in accordance with my usual practice, the result of much experimenting with locomotives on my own road. The barrel on the full-sized engine is made in two rings, the first being parallel, and the second one taper; but it is easier to make ours all in one piece. Some builders may probably ask, why not use a parallel tube, same diameter as the smokebox end of the barrel, and cover it with a taper lagging? That is all right in certain circumstances, such as when the taper is at the upper part of the barrel only; but in the present case, as with *Pamela*, the boiler barrel is a true cone, and tapers at both top and bottom, being $\frac{1}{2}$ in. bigger in diameter at the firebox end. This extra capacity for water and steam is too valuable to throw away, so I have utilised it fully; but at the same time, any builder who doesn't mind sacrificing a little efficiency, can use a parallel barrel if he so desires, camouflaging it with a taper lagging-sheet as suggested; but I might remind him that he won't save any work by so doing, because no lagging is needed on the taper barrel; all we shall want, will be a thin sheet



Longitudinal section of the boiler

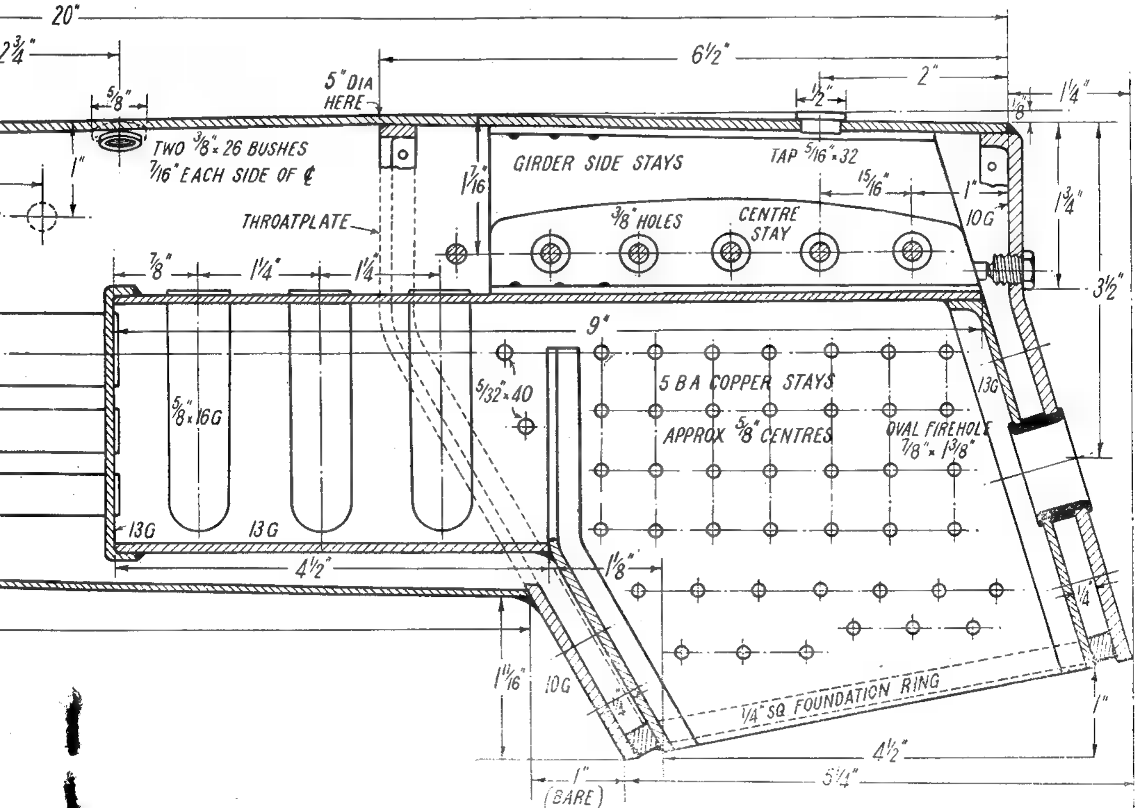
½-in. Gauge by "L.B.S.C."

ucting the Boiler

over the firebox wrapper, to hide the stayheads.

The firebox sides and combustion chamber are made from a single sheet of copper. The combustion chamber is much longer in proportion, than that on the full-sized engine, but it contains "a little bit of something that the big one hasn't got," to wit the water-tubes, which

see that in this one I have reverted to $\frac{1}{4}$ in. I found, for one thing, that the wider water spaces showed no advantage, and this has proved to be the case in full-size practice. I had it "straight from the horse's mouth," that Swindon tried a standard type of boiler with wider water spaces; and not only did it show no improvement, but actually the steaming was not so good as in a boiler with the narrower water spaces. The foundation ring on the full-sized *Britannia* is only $3\frac{1}{2}$ in. wide, which works out at 7/32 in. only, for $3\frac{1}{2}$-in. gauge, so I made it $\frac{1}{4}$ in. to keep an even size, in a manner of speaking. One other advantage is that the firebox staybolts are shorter when the water space is narrower; and last, but not least, less heat is needed to



add to the heating surface in the most valuable part of the boiler, and also keep the water circulating around, making the boiler a very fast and free steamer. The chamber itself requires no staying, the two staybolts which penetrate it each side, being intended for staying the forward part of the outer wrapper. There are plenty of firebox stays, as usual; this enables a thinner plate to be used, gaining efficiency without sacrificing strength. The use of a $\frac{1}{8}$ in. backhead enables fittings to be screwed into the plate without any need of bushes. On *Pamela's* boiler I specified $\frac{5}{16}$ in. water spaces, but you'll

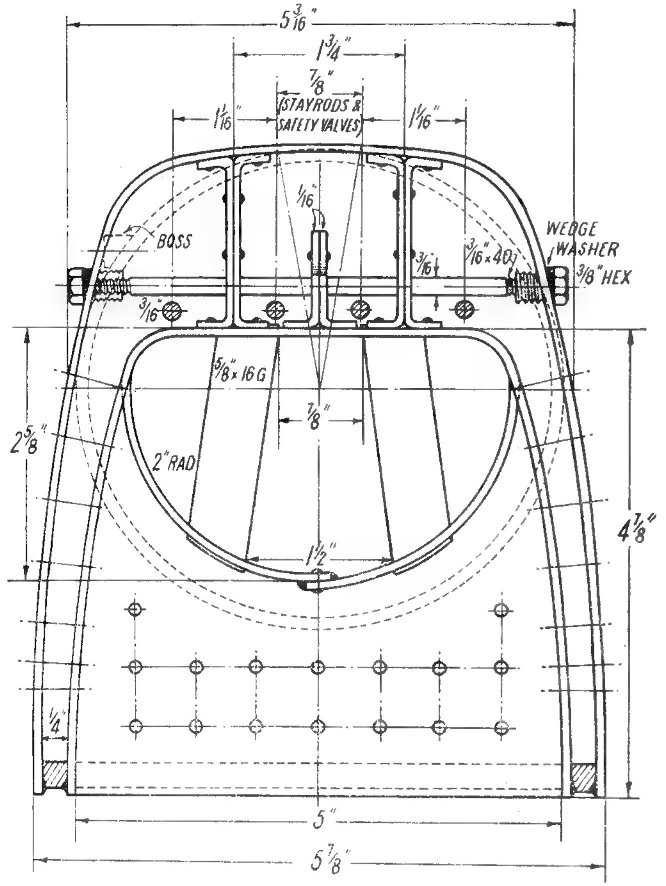
braze up a $\frac{1}{4}$-in. foundation ring than a $\frac{5}{16}$ in. one. So much for generalities; now let us get on with the job.

Boiler Barrel

The easiest way of making the taper barrel, is to use a piece of 5-in. copper tube, 3/32 in. thick (13-gauge) and 15 in. long, slitting it lengthwise, and cutting out a V-shaped piece, a shade over $1\frac{1}{2}$ in. wide at the mouth of the V. Close in the cut, and the result will be a cone of the requisite taper. The joint is made by riveting a butt-strip on the inside; this need only be $\frac{1}{16}$ in.

thick and $\frac{1}{2}$ in. wide, and should stop at $\frac{3}{8}$ in. from the smaller end of the barrel, or you'll have a job to fit the smokebox tubeplate. Use 3/32 in. copper rivets, heads inside the barrel and countersunk on the outside. Before riveting up, clean the joint for $\frac{1}{4}$ in. either side inside the barrel, and have the butt-strip thoroughly clean, too. Use No. 41 drill for the rivet holes, at about $\frac{1}{2}$ in. spacing, and stagger them.

The way I usually do the job is to cut the V,



Cross section through firebox

close up the gap, then put a couple of clips around, one at each end, to hold the edges together; the edges, by the way, should be slightly bevelled off toward the outside. All the rivet holes are then drilled, and the burrs inside cleaned off with a file. The butt-strip is then fitted inside and riveted through two holes at each end; this will allow the clips to be removed. The rest of the holes are then drilled, putting a piece of wood inside the barrel to keep the butt-strip in contact with it. All burrs are filed off, the holes in the barrel are countersunk on the outside, and the rivets put in. I use a piece of $1\frac{3}{4}$ in. round steel bar held in the vice jaws for a riveting dolly; the hardened insets are removed from the jaws, and the bar rested on the "steps," so that it doesn't fall down during the hammer-and-plonk business.

The barrel can also be rolled up from sheet copper of 13-gauge; I use this method when I have no suitable tube, as I have a set of bending rolls. A piece of copper about $15\frac{1}{2}$ in. across, will be required, the width at one end being approximately 16 in., and at the other, $14\frac{1}{2}$ in. This will allow for a $\frac{3}{8}$ in. overlap, and no butt-strip will be needed, the joint being cleaned and single-riveted with 3/32 in. rivets, as before. The small end can be squared off in the lathe, in the same way as I have described for squaring off the ends of parallel boiler barrels made from tube.

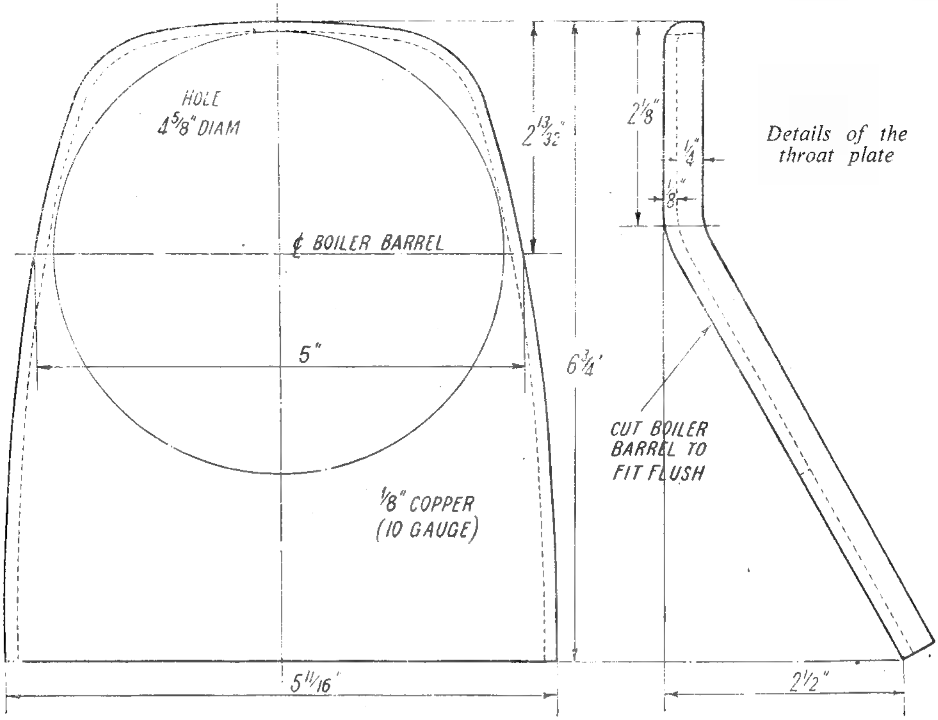
First Brazing Job

It is a good wheeze to braze up this joint right away, as there isn't so much metal to keep hot, when the barrel isn't connected to the firebox casing. Give it a good dose of wet flux—Boron compo, or powdered borax, mixed to a paste with water—both inside and out. Put it in your brazing pan, pile coke or breeze all around, and put some inside, to within about $1\frac{1}{2}$ in. of the joint. Get your blowlamp or blowpipe going good and strong, and heat up the whole lot until the moisture dries out of the flux; then concentrate the flame on one end, and when it reaches bright red, apply the end of a stick of easy-running brazing material to the joint, in the flame. Any good easy-running brazing strip will do; even soft brass wire, but this needs a very bright red heat. If you have enough "therms," the material will melt and flow into the joint; then, very slowly, move the flame along, feeding in the brazing material as the metal reaches the requisite heat. If it goes lumpy and forms what the kiddies call "almond rock," the job isn't hot enough; remedy obvious!

When you get to the end, turn the barrel over and take a look inside. If the job has been properly done, you'll see the brazing material showing all along the joint. If not, lay the barrel on the coke, joint downwards, and have a go at the inside, applying more flux, blowing on it with the flame, and feeding in a little more of the brazing material. Coarse grade silver-solder may be used for this, if desired, as it only needs a dull-red heat. When all is O.K. and the joint perfectly covered, rivet heads and all, let it cool to black, and then quench it out in acid pickle (1 part commercial sulphuric acid to about

16 of water). Leave it in from 15 to 20 mins., then wash off in running water, and clean up with a handful of steel wool. Any superfluous blobs of brazing material on the outside, should be filed off, leaving ■ perfectly smooth joint.

Anybody having oxy-acetylene equipment available, should use Sifbronze No. 1 rod. No need to bother about the inside. Just cover the outside of the joint with the special Sifbronze flux, mixed to a paste with water ; heat evenly until all the moisture dries out, then start at one end, blowing to very bright red, and apply the rod in the flame, letting the melted metal drop into the joint, each drop overlapping the previous one, so that you get a rippled appearance all the way along. So long as the V-groove is completely filled up and the rivets covered, the job will be O.K. as the Sifbronze is actually stronger than the copper itself. A Sifbronzed copper joint, tested to destruction, tears away at each side of the joint, and the latter doesn't "give" at all. It is hardly necessary to add that I am Sifbronzing my own boiler.



Details of the throat plate

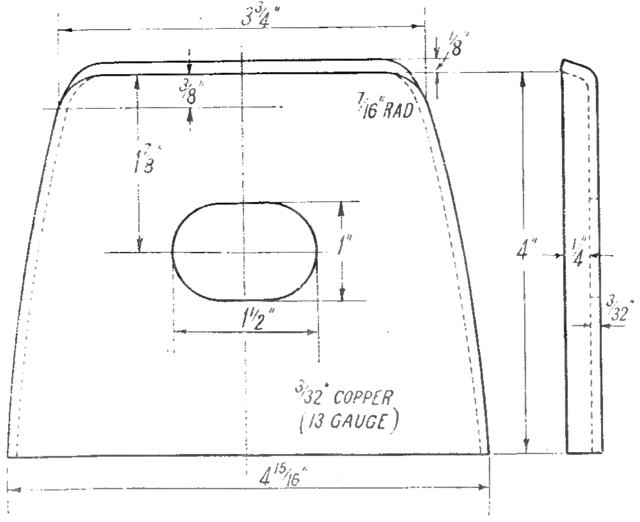
Throatplate

It is advisable to make an iron former, on which to flange the throatplate and backhead, from $\frac{1}{4}$-in. steel or iron plate. If a good hacksaw is used with ■ drop of cutting oil, as used for turning steel, to help the saw on its way, it doesn't need ■ great deal of exertion to saw out the plate. This is cut to the shape shown in the drawing of the throatplate, but $\frac{1}{8}$ in. less in dimension all around except at bottom, as indicated by the dotted lines. The bottom should be made $\frac{1}{4}$ in. longer, to allow for the slope when the throatplate is bent as shown in the side view. Round off one edge of the former.

Lay the former on a piece of $\frac{1}{8}$-in. copper sheet and scribe a line all around it, except at bottom, about $\frac{5}{16}$ in. away from the edge. If you haven't a bench shear that will cut $\frac{1}{8}$-in. copper, saw out the piece (a dose of cutting oil helps a lot) and soften it by heating to red and plunging into water. Then clamp it to the side of the former with the rounded edge, holding in the bench vice, and beat down the projecting metal on to the edge of the former with a decent-sized hammer. I use a two-pounder for this orgy of walloping. If the metal goes hard or shows signs of buckling or cracking, re-anneal at once. The $\frac{1}{8}$-in. copper will flange quite readily. When through, file off any raggedness and clean the flange itself with a coarse file ; the rough scratches form ■ nobby "key" for the brazing material, so in this case, *don't* aim for ■ swell finish !

At 2 13/32 in. from the top, scribe ■ line across the embryo throatplate, and from the middle of this, strike a circle with dividers, $4\frac{5}{8}$ in. diameter. Cut out the marked circle, either with a coping saw (glorified fretsaw) or by drilling holes all around and breaking out the piece, trimming up with ■ half-round file. Here again, your humble servant does the job the easy way, for I have ■ Driver jigsaw which cuts holes and fancy shapes in $\frac{1}{8}$-in. metal like ■ kiddy's pedal fretsaw machine cuts plywood. Next, at $2\frac{1}{8}$ in. from the top, the throatplate has to be bent back to the

angle shown in the side view. The easiest way to do this, is to cut a nick in the flange, at each side of the hole. It doesn't matter a bean if this nick doesn't close right up when the throatplate is bent to the required angle, because the gap will be inside the wrapper sheet, and will be filled up automatically with brazing material when the barrel is brazed to the throatplate.



Firebox door plate

Firebox Shell

The firebox shell, or wrapper plate, will need a piece of 3/32-in. or 13-gauge sheet copper measuring 17-in. × 7¾ in. Now the finished wrapper is a rummy sort of shape when you look at it sideways; it has a back slope at the front (says Pat), the bottom slopes upward and the back edge, after a vertical drop of 1¾ in., also takes a back slope corresponding to the front one, as shown in the longitudinal section of the boiler. Our friends who do everything by calculation, would doubtless use up about four pages in giving more or less explicit instructions on how to calculate the various angles, etc., for marking out the whole bag of tricks on the flat sheet; but your humble servant knows a trick worth two of that, thanks to the dressmaker for whom I acted as a living dummy in my childhood days. Just get a bit of stiff brown paper, the same size as the copper sheet; bend it around the throatplate flange, securing with paper clips, or anything else you fancy. Mark the bits to be cut away, with an ordinary pencil, and cut them with the domestic scissors until you have a paper replica of the wrapper, cut to the dimensions shown in the section of the boiler. Take the paper off the throatplate, lay it out flat on the copper sheet, mark the outline of the paper pattern, cut away the unwanted parts, and the piece that is left will bend up into the correct shape. It doesn't matter if you spoil a dozen pieces of paper, the cost is infinitesimal (says the third programme), but if you spoil the one and only bit of copper sheet that you have suitable for the wrapper, the ensuing remarks might not be of third programme quality. When bending the copper, don't forget to allow for the ⅛ in. drop in the top line of the wrapper. You needn't bother about it on the paper pattern.

Riveting

Rivet the front end of the wrapper sheet to the throatplate flange, using 3/32 in. copper rivets, heads inside. No need to bother about fancy pimples outside, as they are all filed away after brazing. Set the edge of wrapper sheet level with front of throatplate, as shown at the top of the sectional drawing. The large end of the barrel has then to be fitted, so that it butts up against the throatplate, and is parallel to the firebox shell. At 1½ in. from the wider end of the barrel, and exactly opposite to the longitudinal seam, make a vertical cut 2⅛ in. deep, and then saw diagonally from the bottom, to meet it. This gives the approximate angles at which the barrel meets the throatplate; and a little judicious filing should make a close-fitting contact. The fit need not be *too* close; in fact, it is better if it isn't, as a little gap here and there, will allow the brazing material to penetrate better.

Second Stage of Brazing

Stand the firebox shell, throatplate up, in the brazing pan and pile up the coke or breeze nearly to the top. Stand the barrel on the throatplate, making sure it is in the right position and parallel with the firebox shell. Anoint the joints well with wet flux, heat up until all moisture is dried out, then concentrate on the bottom corner of the throatplate-wrapper joint, blow to bright red and apply the easy-running brazing strip. The rest of the job is done exactly as fully described for *Tich*. Work your way right around, doing the whole of the circumferential joint, filling up the corners of the wrapper where they join the throatplate, as you pass them. Leave a good fillet of brazing material the whole way around the joint between barrel and throatplate, and at the top corners of the wrapper, as the brazing is the only means of holding the joint. This is no detriment, because the brazed joint, if properly done, is stronger than the metal of the boiler. We can't fit a "piston-ring joint," owing to the shape of the throatplate; but the four longitudinal stays in the finished boiler would prevent the parting of even a badly-brazed joint. When the barrel joint is finished, complete the other bottom part of the throat-plate-wrapper joint; then let cool to black, quence in the pickle, leave it from 15 to 20 minutes, wash in running water, and clean up as before. Next stage, firebox and combustion chamber.

"Talking about Steam——"

by W. J. Hughes

A series of articles intended to supply suggestions and information for the would-be "modeller in steam" who has not the time, the inclination or the opportunity for extensive research

8—More Engines from the Vienna Exhibition

WHILE on the subject of the Vienna Exhibition of 1873, two exhibits from which were described in the last article, we may as well deal with two other interesting prototypes which were to be seen there.

This was the heyday of the steam engine, of course; many firms in many countries were turning out thousands a year between them, and it is a great pity that the craft of model engineering was not so popular in those days as now. Had it been so, we should have many more excellent models to guide and inspire us than exist today in collections and museums. But I suppose that the average man of those days had neither the leisure nor the financial opportunity to indulge in the hobby, even if he had the inclination.

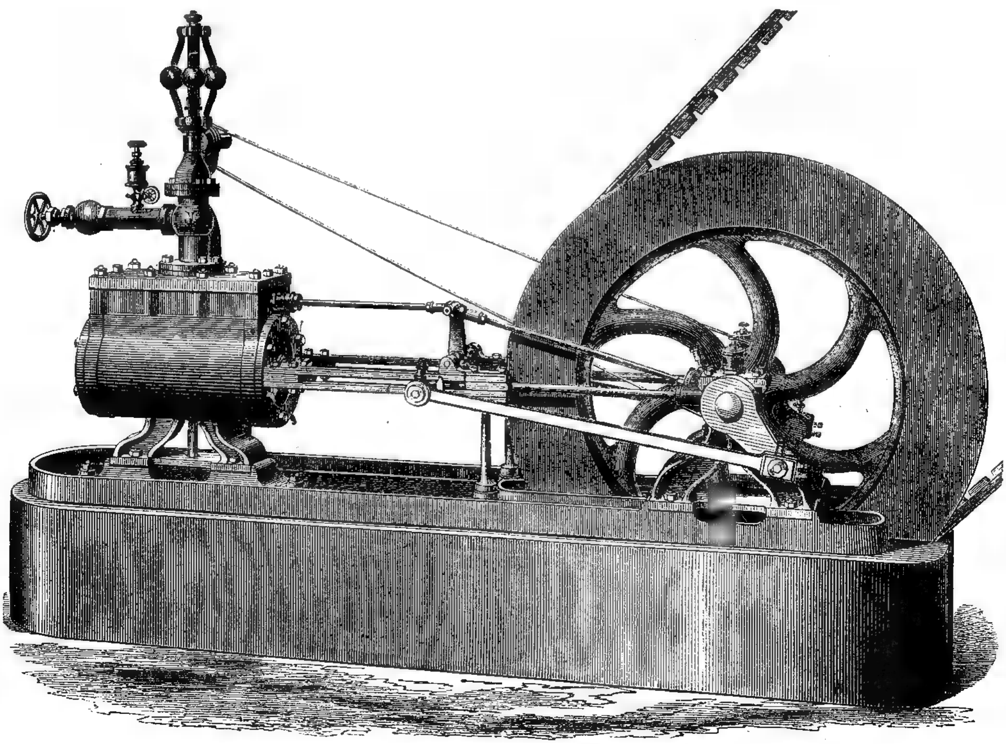
Continued from page 128, "*M.E.*," *July* 24, 1952.

A Horizontal Engine

An out-of-the-ordinary horizontal engine is shown in Fig. 34, and by virtue of the uncommon points of design it would be worth re-creating in a small edition.

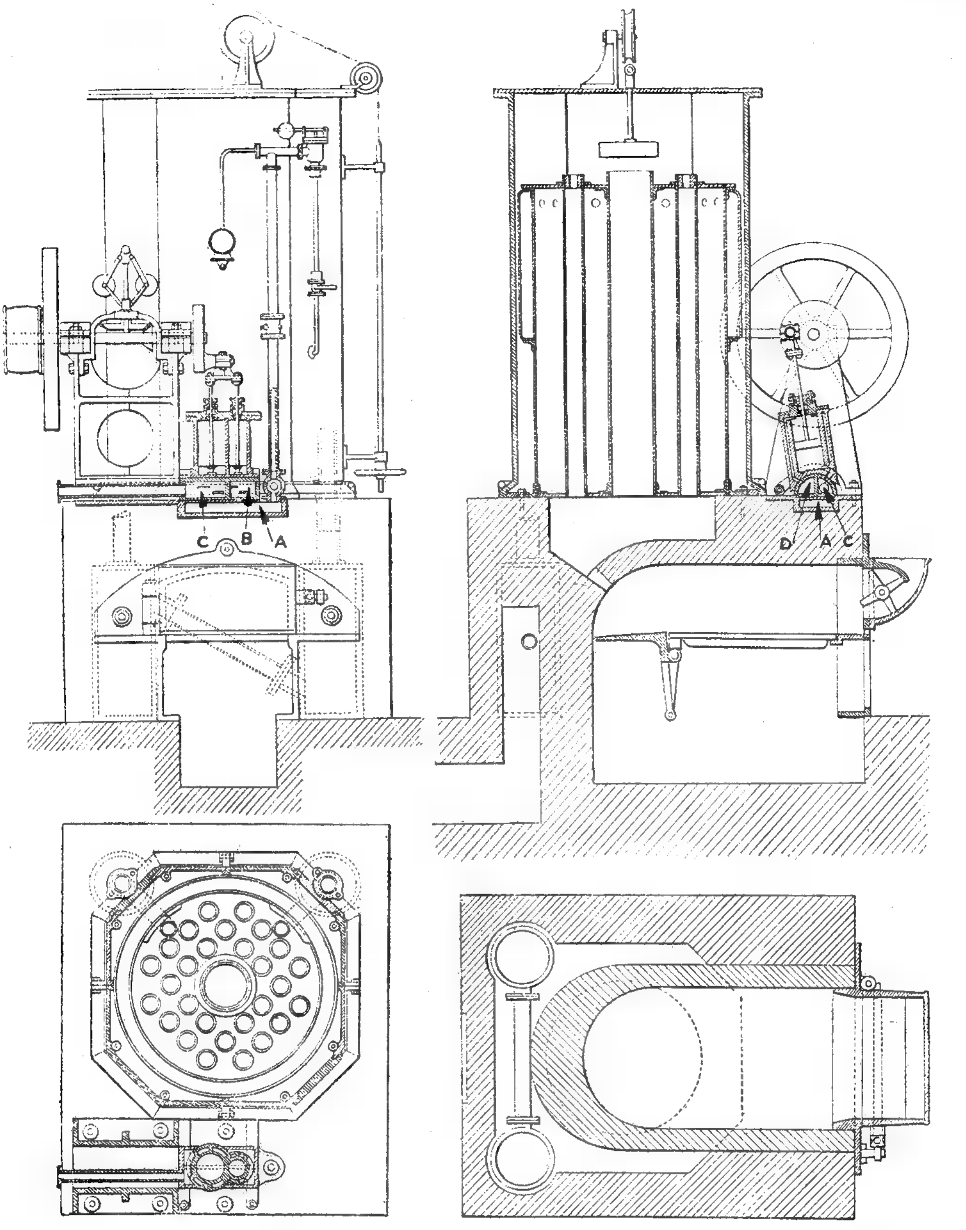
The prototype was built by Messrs. Pickering and Davis, of Portland, U.S.A. Unfortunately, no scale is available, but obviously the engine is only of a small horse-power.

A heavy box-form cast-iron pedestal is used as a foundation, with the cylinder and the crankshaft supported on separate pedestals. Note that these pedestals fit closely between lips cast and machined on the foundation.



By courtesy] [*John L. French*

Fig. 34. *An American horizontal engine which was exhibited at the Vienna Exhibition of* 1873



By courtesy] [*John L. French*

Fig. 35. *Another Vienna exhibit : a compound oscillating engine which possesses several interesting features*

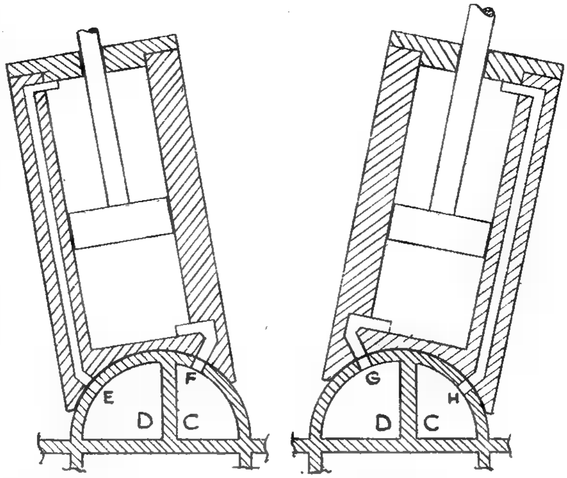
The flywheel has a deep but narrow rim, machined with a vee-shaped groove to take the vee-belt known as "Underhill's Driving Band," and fits between the two crankshaft pedestals. Overhung cranks are fitted at both ends of the shaft, so that there are twin connecting-rods also.

It will be noticed that the cylinder is stayed direct to the crankshaft pedestals, through the slide-bars and thence through twin stays which pass each side of the flywheel to the tops of the pedestals. The outer ends of the slide-bars are also supported on turned columns, palmed out at the top : the inner ends by the cast brackets on the cylinder cover.

The Cylinder

Apparently the cylinder is cast in one piece with its foot, since the lagging is not thick

enough to conceal the flanges and fixing bolts that would otherwise be necessary.



Figs. 36 *and* 37. *Two diagrams to show how the steam is admitted and exhausted from the oscillating engine. See text. For simplicity, only one long passage is shown in each illustration*

The steamchest is a separate casting from the cylinder—a feature often found in model steam engines but not so common in prototype engines. It is secured, of course, by the studs which also hold the cover in place.

An eccentric mounted between flywheel and near bearing drives the valve through a rocker mounted in brackets fastened to and holding down the slide-bars. Since the end of this rocker moves in an arc, it is assumed that the pin may move in a small slot in the arm, otherwise undue wear would take place in the valve-gland owing to the forced vibration of the rod, but there is no indication of this. Alternatively, it is more likely that the eye of the valve-rod may be slotted slightly—the vertical movement of the pin would be very small in any case.

A Pickering governor is mounted on top of the valve-chest, driven by a pulley between the flywheel and far bearing, and there is a screw-down regulator valve. Note the displacement lubricator on the steam-pipe between the two.

An Engine from Switzerland

A compound oscillating engine was exhibited at Vienna by B. Morell, of Berne, Switzerland, and is shown in Fig. 35. I am including this layout principally from the point of view of the engine itself, and not particularly for the boiler. The flue arrangements of this could well be modified in a model, or the engine alone would make an excellent model for a showcase, or to run from a separate stationary boiler.

It will be seen that the engine is inverted, with a heavy cast frame supporting the crankshaft. A disc crank is fitted to the latter, and the cross-head is common to both piston-rods.

The cylinders are side by side, cast in one piece, and are machined out underneath to oscillate on a semi-cylindrical trunnion. A lug is cast on each end of the base, and turned concentric with the machined underside of the cylinder-block. The latter is then held down on to the trunnion by two clips, one of which may be seen in the side elevation, passing over these lugs, pivoted at the inner end and bolted down at the outer. Thus the cylinder block may oscillate on the trunnion.

A steam passage is cast on each side of each cylinder, and these may be seen in the side elevation and plan. In the latter, however, it appears that there are *two* passages on each side of each cylinder, but actually only one of these extends to the top, the other one being connected to one of the ports at the lower end of the cylinder.

The side elevation shows a section through the low-pressure cylinder, of course, and it will be seen that the semi-cylindrical trunnion is divided, to make two passages. A further glance at the front elevation will show that the nearer (in this elevation) of the two passages is again divided into two, transversely.

Steam from the boiler is taken to the cavity *A* cast in the baseplate, and from this enters cavity *B* in the trunnion. Having passed through the high-pressure cylinder, it exhausts into cavity *D* (side elevation), which thus acts as the receiver. From *D* the steam passes through the low-pressure cylinder and thence to cavity *C*, from which it is exhaused to atmosphere through the pipe seen in front elevation and plan.

Admission and Exhaust

Steam is admitted to and exhausted from the cylinders through ports cut in the walls of the trunnion, and through corresponding ports cut in the concave base of the cylinder block. The latter communicate, of course, with the passages running to the ends of the cylinders. Opening and closing of the ports is effected by the oscillation of the cylinder.

Sequence of Events

Perhaps we can best follow the sequence of events from the low-pressure cylinder, as seen in the end elevation. However, since the detail in this is not as clear as it might be, I have re-drawn the cylinder in Figs. 36 and 37, (though not to scale).

It will be recalled that the receiver *D* is full of steam exhausted from the high-pressure cylinder. In Fig. 36, the left-hand passage is shown open to the receiver through the port *E*. Steam is, therefore, being admitted to the top end of the cylinder, pushing the piston downwards. At the same time the exhaust passage at the right lower end of the cylinder is open to the main exhaust passage *C* through the port *F*.

In Fig. 37, the cylinder has oscillated with the revolution of the crank, and now the piston is moving in the upwards direction. Steam is being admitted below it through port *G*, and is being

(*Continued on page* 259)

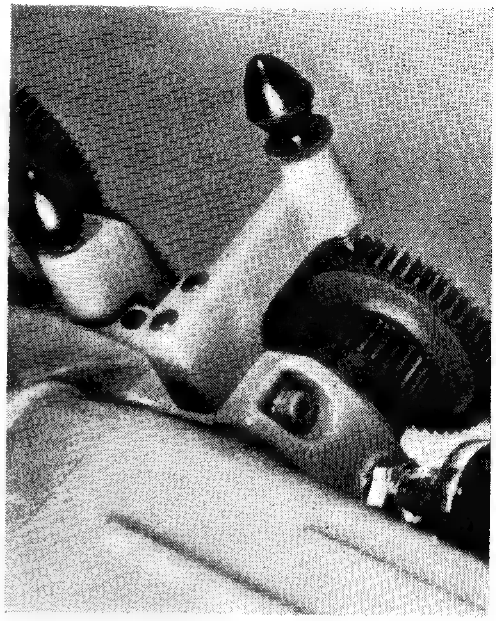
AN INDEXING ACCESSORY FOR THE M.L.7

by A. L. N. Stephens

THE accessory illustrated is designed to conform with the general appearance of the M.L.7 lathe, and to be attached as ■ semi-permanent fitment. It does not interfere with the guards and they may remain in use except when indexing, when, of course, the change wheel guard will be removed.

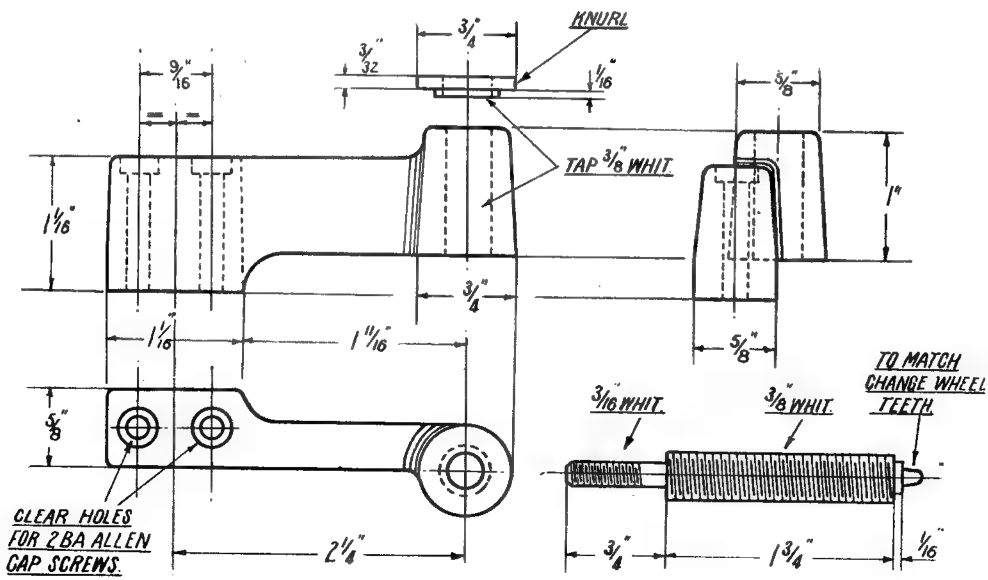
The bracket is an iron casting and is secured to the headstock casting immediately below the outer mandrel bearing cap with the top edge level with the joint. The headstock casting is drilled and tapped 2 B.A.

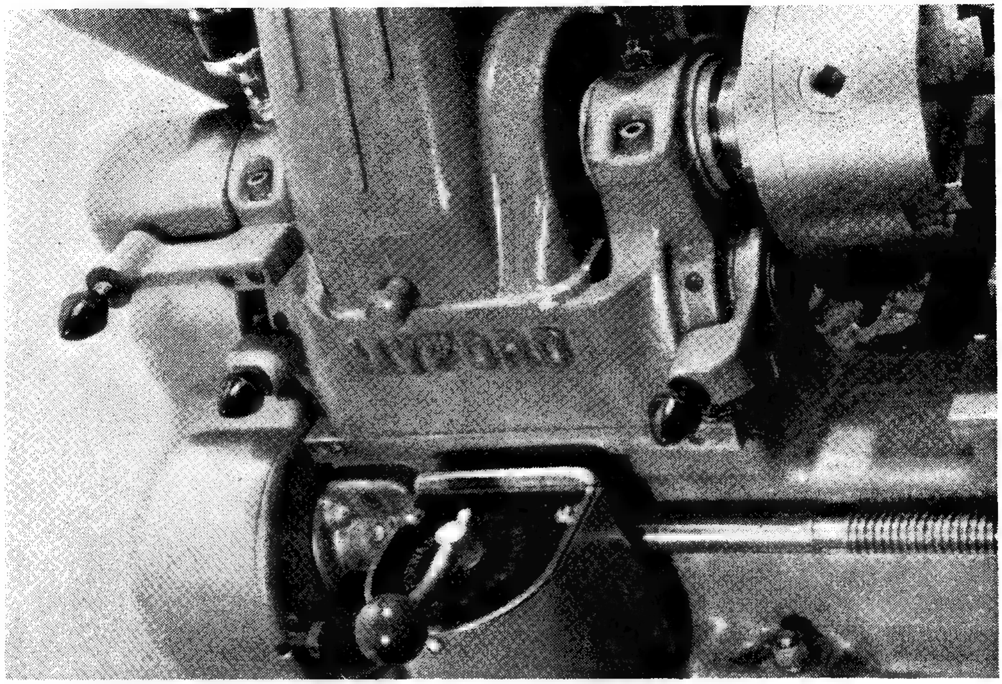
It is advisable to make ■ simple drilling jig, used located on the lower half bearing bolt holes. In any event, the mandrel and outer bearing shells should be removed before drilling to avoid damage to the lower half of the shell. The 2-B.A. holes should be drilled spaced equally either side of the bearing bolt hole ; it is preferable that they should be lightly spot-faced to provide ■ seating for thin washers inserted between the bracket and the headstock. Each of these washers is of a thickness to provide ■ level surface on which to secure the bracket. However, spot-facing is not essential and with the use of judicious packing, the bracket can be secured firmly. Plain 2-B.A. holes are not conspicuous and can be filled with Allen grub-screws, should disposal of the lathe without the indexing attachment be considered.



The accessory in use

The detent is made of ■ ⅜-in. M.S. bolt and is fitted with a duplicate of the Myford acorn knob made from plastic or ebonite, or these knobs are obtainable from Myfords for ■ few





pence. The locking ring is of M.S. and is knurled to match the acorn knob and blued by heating to red heat and quenching in oil. A screwed detent with locking ring is used in preference to a plunger type, as it is more rigid and will remain so.

Dimensions shown are for use with change wheels of from 50 to 64 teeth; a longer detent will be required for smaller wheels.

The bracket should be painted to match the M.L.7 grey; it will be found that Rocket L.N.E.R. wagon grey is a very similar colour.

The writer will be pleased to lend his pattern or obtain castings for anyone needing that assistance in making up the attachment.

The photographs were taken by Mr. K. F. Stephens using a Leica III with a 10.5 cm. lens.

"Talking About Steam——"

(*Continued from page* 257)

exhausted above it through the long right-hand passage and port *H*.

Ports *F* and *H*, and the similar pair of ports for the high-pressure cylinder, may be seen in the front elevation.

The arrangement of events for the high-pressure cylinder is similar to that for the l.p. side, of course, except that the steam is admitted from compartment *A* (front elevation), and exhausted to the receiver *D*.

Not Very Economical

In actual practice, this engine would not be very economical, in spite of being a compound, because of the long steam passages from the upper end of the cylinder. For, looking at Fig. 36, where steam is being admitted above the piston, not only has the inlet passage to be filled with steam at every stroke, but the long exhaust passage leading from this end will be filled as well. And as soon as the exhaust port opens, all that steam will be blown to waste, without having done a ha'porth of work on the piston!

However, in a model we need not usually bother too much about economy, and I feel that a small engine built on these lines would be well worth while. The best way of making the cylinders and trunnion would be by fabrication, either by silver-soldering, brazing, or welding the parts together, and the main frame of the engine could also be built up, with less trouble than making a pattern and machining a casting. Certainly when the model was finished, you would have an example of an engine which would not be common, and which would create great interest at any exhibition!

(*To be continued*)

Shaping Operations in the Lathe

by "Duplex"

CUTTING ■ keyway in ■ pulley or in ■ sliding collar can be done in several ways in the workshop, and of these the oldest is by the use of hammer, chisel and file. But with machine tools coming into general use, the slotting or shaping machine is now usually employed for this purpose, except in large factories where ■ broaching machine would probably do the work on ■ large scale at less cost. In the small workshop, however, apart from a drilling machine, the lathe may be the only machine tool. As some ways of adapting the lathe for carrying out shaping operations have already been dealt with, it is now proposed to describe the method of using these attachments for doing some of the more common workshop jobs, such as: internal and external keyway cutting, and the machining of pinions and small toothed cutters.

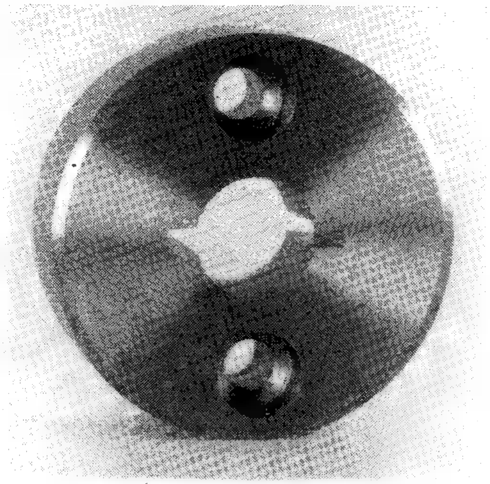


Fig. 1. A drive collar with two keyways cut in the lathe

Where the bore of the part to be keywayed internally is of small diameter, the tool used for cutting the keyway must be correspondingly slender and is, therefore, liable to whip under the pressure of the cut. This lack of rigidity in the

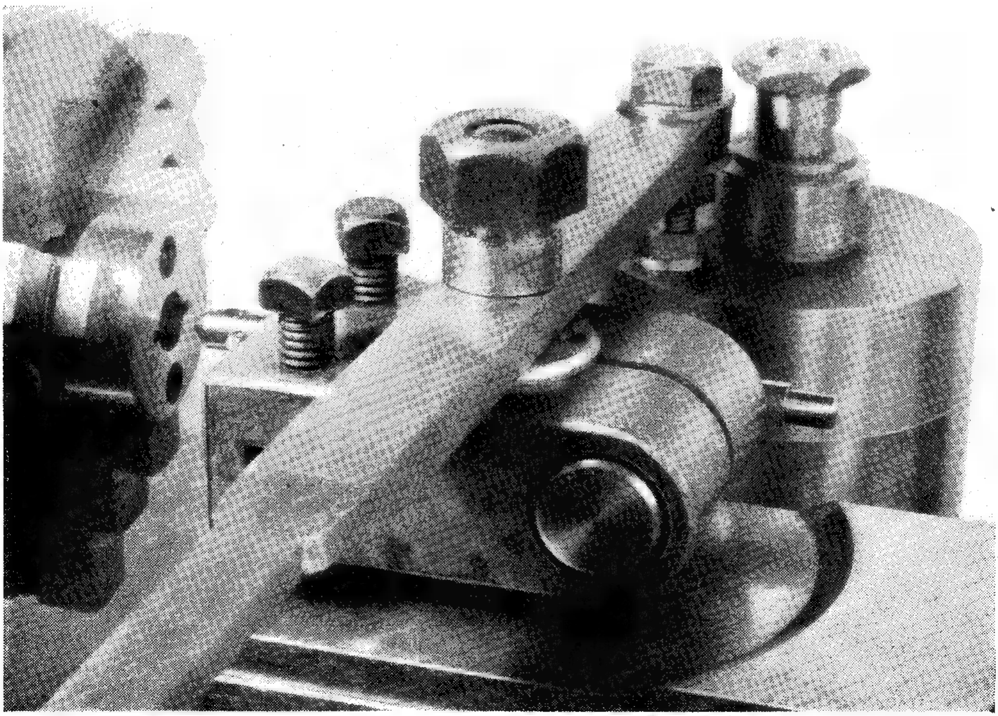


Fig. 2. The lathe set-up for cutting internal keyways

tool can, in part, be offset by adopting the method used in broaching; that is to say, the tool is pulled and not pushed through the work. A typical work-piece is shown in Fig. 1 and, here, two keyways, spaced at 180 deg., have been cut in a collar designed both to take the drive and to slide on the spindle of a drilling machine. The lathe set-up for this operation is illustrated in Fig. 2, and it will be seen that the shaping attachment, previously described, has been rigged on the Drummond lathe. A small boring bar, holding a square-ended cutter-bit, is carried in a T-headed toolholder, and the tool itself is mounted in the toolpost. No top rake should be given to a tool for machining brass, and only very little rake should be used when cutting keyways in steel, otherwise the tool is liable to dig-in and jam in the work.

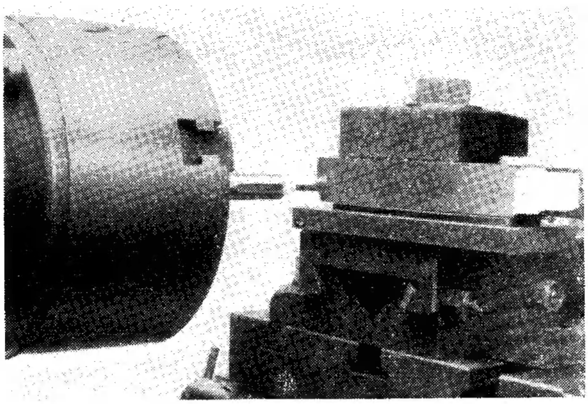


Fig. 3. Cutting an external keyway

When the bore has been machined, the work-piece is left in the chuck and the mandrel is locked. After the cutter has been adjusted to lie horizontally, the next problem is to set the centre-line of the tool at exactly centre height, so that the centre-line of the keyway will be truly radial.

A method that has been used with success is, immediately after the boring operation, to lock the lathe mandrel from the bull wheel and then scribe a line across the face of the work with a pointed tool set at centre height. When the cutter is brought level with the work, there will then be no difficulty in setting the tool centrally on the scribed line. After the tool has been fed outwards to make contact with the bore, the cross-slide index is turned to zero and then locked. While the tool is worked to and fro with the hand lever, a small cut of two or three thousandths of an inch is put on at the end of each idle stroke, but from time to time the tool should be operated for a few strokes without increasing the feed, in order to offset any spring in the tool or shake in the lathe parts. After the keyway has been cut to the required depth, the reading of the cross-slide index is noted as a guide when cutting the second keyway.

To cut the remaining keyway, the mandrel is locked, after being turned through 180 deg., by re-engaging the detent in a tooth space diametrically opposite to that first located.

When fitting the keys to the drilling machine spindle to engage in the driving collar illustrated, it will be found difficult to support the long,

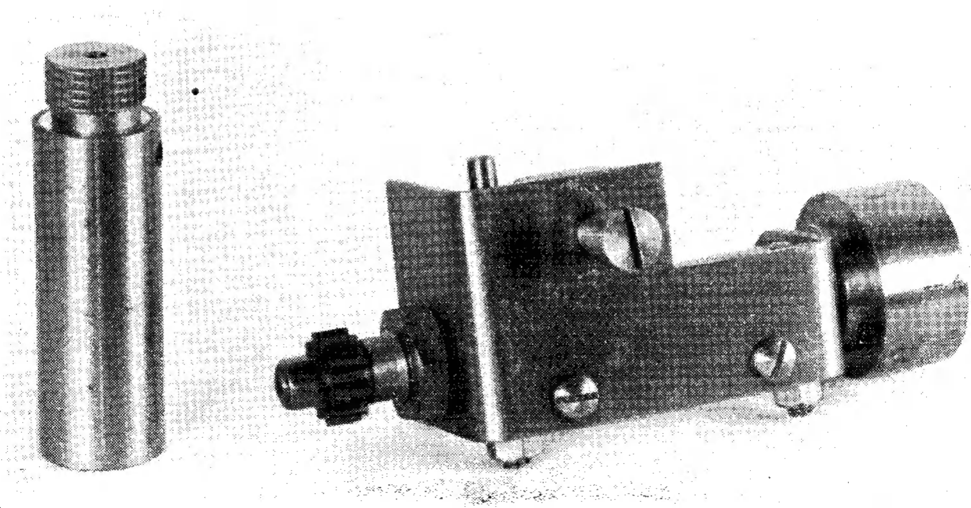


Fig. 4. Left—a lighter wheel shaped in the lathe; Right—a bronze pinion with shaped teeth

slender spindle well enough to enable the two keyways to be cut by shaping in the lathe. The method adopted, therefore, was to form the keyways by a fly-cutting operation, using the small boring bar and cutter illustrated. Next, the width of the cutter was reduced ½ thousandth of an inch by stoning, and the cutter was then used to shape the two keyways in the sliding drive collar. As a result, the keys, when made a press-fit in the collar, were a close sliding-fit in the spindle keyways.

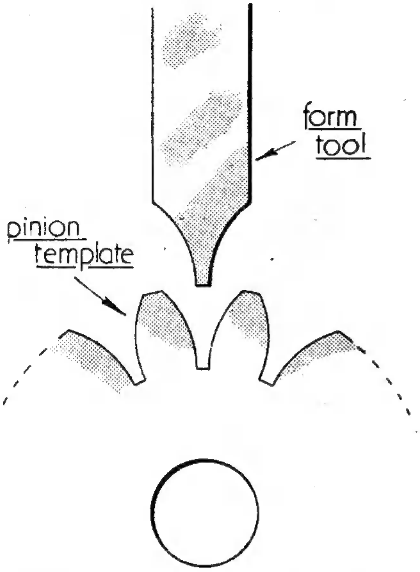


Fig. 5. Form tool for shaping pinion teeth

An alternative and equally satisfactory way of cutting internal keyways is that described in a recent article in THE MODEL ENGINEER, where a tool shaped like a parting tool is mounted in the toolpost, and the tool's long axis is set in line with the keyway.

The machining operation is similar to that already described, but the tool then cuts on the forward stroke, and care must be taken to avoid digging-in by taking only light cuts.

Should the work be machined with a tapered bore, formed by setting over the topslide, this slide setting is preserved for cutting the keyway. In this way, the key, when fitted, will lie parallel with the taper.

Machining External Keyways

The lathe set-up for machining a short external keyway in the end of a shaft is illustrated in Fig. 3, and, here, a tool having the rake and clearance angles of a parting tool may be employed. Where the fulcrum pillar is secured to the lathe bed, the tailstock will have to be removed, but with the attachment described for the Drummond lathe the tailstock remains on the bed and can usually be brought up to support the overhanging end of a long shaft.

An easy way of setting the tool to centre height is to feed a tool inwards across the end of the work, so as to leave a pip approximately equal in diameter to the width of the keywaying tool ; this pip is then used as a setting guide.

Before starting to cut an external keyway, a shallow recess, equal to the width of the keyway, should be formed with a drill or an end-mill so as to give clearance for the tool at the end of the stroke. It will also save time, and may make a neater job, if a stop is arranged to limit the travel of the topslide and check the tool when it reaches the diameter line of the drilled recess. By setting over the topslide, a keyway can be cut in the same manner on the tapered end of a shaft, and this may be found more convenient than fitting a Woodruff key.

Machining Small Pinions

It is not suggested that pinions and gear wheels can be accurately cut by the methods described, but when pinions are required merely to actuate a simple mechanism at slow speed, they can be shaped quite well in the lathe.

An example is given in Fig. 4, where a small, 10-tooth, bronze pinion is driven from the feed-screw of a machine slide and rotates an indexing drum. Here, accuracy of tooth form is not important, as long as the pinion will mesh freely and without excessive backlash. Reasonable accuracy can be obtained by using a form tool to cut the teeth, and the tool is filed to shape by employing as a template a standard gear wheel of equivalent pitch and having as nearly as possible the same number of teeth.

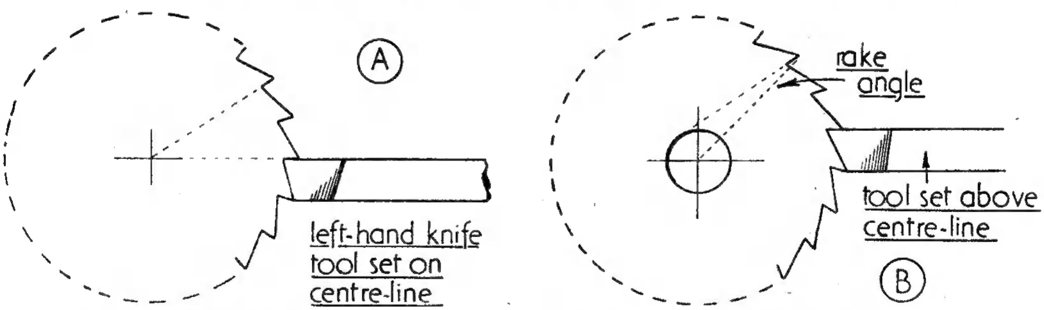


Fig. 6. "A"—teeth formed radially with a knife tool ; "B"—undercutting the teeth

Making Cutters

Small cutters can also be machined in this way, and Fig. 4 shows a petrol-lighter wheel in the making from silver-steel rod. The blank was machined with 33 teeth by indexing from every second tooth space on the bullwheel, but if the finished cutter is to be used for milling, the teeth should be more widely spaced to prevent clogging when at work. A left-handed knife tool has been found to serve well for machining the teeth; if the tool is mounted at centre height, Fig. 6A, the teeth will be radial, but by setting the tool above centre height, Fig. 6B, the teeth will be given cutting rake.

Relieving the Tool on the Idle Stroke

When cutting keyways or machining pinions in mild- or silver-steel, it has been found that a high-speed steel tool, when kept lubricated, does not need to be given relief on the backward or idle stroke, but if the same method is used for machining bronze parts, the clearance at the tool's cutting edge is soon worn away. This difficulty is usually overcome by withdrawing the tool from the work before beginning the return stroke, for it is hardly worth while making a special tool holder, furnished with a clapper box like that fitted to shaping machines.

Shaping Across the Work

So far, only shaping in line with the lathe axis has been considered, but it is equally possible to shape in a direction across the work with the topslide rotated through 90 deg. This method of shaping is illustrated in Fig. 7, where the form of attachment used with the Drummond lathe is shown.

Although the tool is shown with its long axis nearly in line with the work face, the parting tool used can also be set so that it cuts in the normal manner, as in an ordinary parting-off operation.

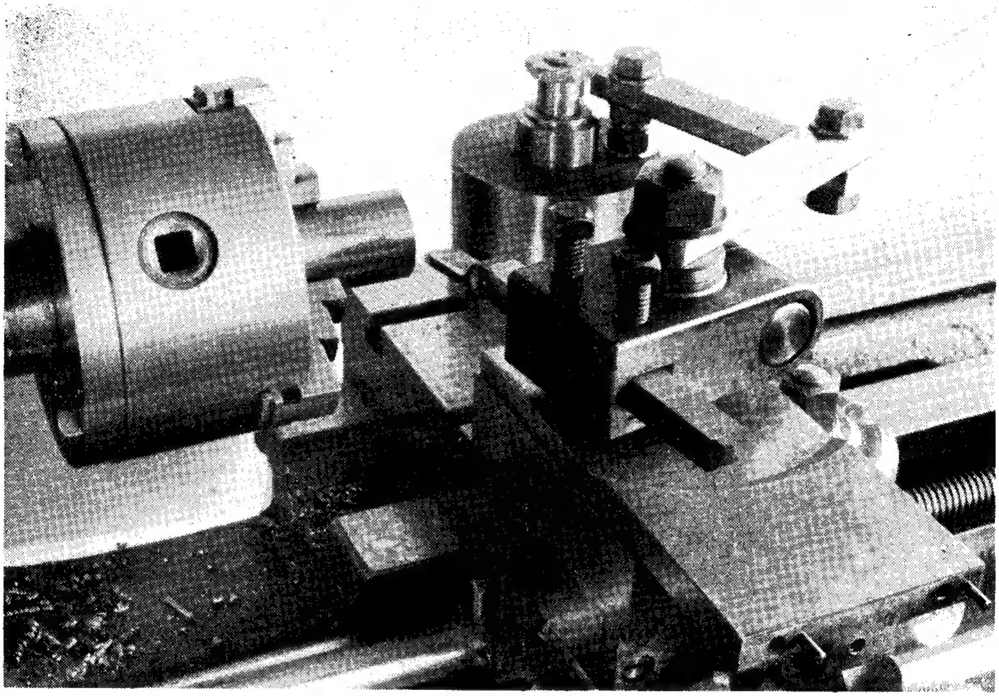


Fig. 7. The shaping attachment adapted for machining the end of a shaft

To enable the topslide to be actuated, a link-rod is connected between the hand lever and the fixed fulcrum post. The lathe tailstock will, however, usually have to be removed to allow the lever to have its full range of travel.

This set-up has been used for slotting the end of a small shaft to take a driving feather. In this way, also, the teeth can be cut on the end face of a small milling cutter, so that by employing two shaping operations an end-mill can be machined.

When forming the cutter teeth on the end face of the work, it is advisable to drill a central countersink with a centre drill and to arrange a stop for the slide, so that the tool cannot travel past the centre-line and possibily damage any teeth already cut.

Finally, it should be emphasised that, in the circumstances outlined, there must necessarily be some lack of rigidity both in the work mounting and in the moving parts; only light cuts should, therefore, be taken, and the rapid removal of metal can hardly be expected. Nevertheless, many awkward jobs can be done quite satisfactorily by adopting the methods suggested.

PRACTICAL LETTERS

Old Steam Engines

DEAR SIR,—I was interested in the letter from John E. Brewer in the July 31st issue. I cannot answer his final query, but am wondering if he has seen the fine beam engine at Moors Gorse Waterworks, Staffs. It is situated on B5013, midway between Rugeley and Hednesford. It was built in 1873 by Messrs. James Boulton & Watts, and when I last saw it in June, 1949, was going strong and capable of considerably more useful service. Permission to view the whole of the engine has to be obtained (apply to waterworks engineer), but its beam is in full view at the side of the road.

Yours faithfully,

Guildford. W. E. ROBERTS.

DEAR SIR,—In your "Practical Letters" of the issue for July 31st, an enquiry is made by Mr. J. E. Brewer regarding a building on the Lichfield Road, in which a large flywheel can be seen revolving.

This would appear to be the Pipe Hill Pumping Station of the South Staffs Waterworks Co., which I was privileged to visit quite recently through the courtesy of the engineer-in-chief of that company.

Installed in this building are two enormous steam-driven horizontal engines which drive the pumps. These engines are maintained in a most beautiful condition.

The boiler house, in which there are three boilers, working at 100 p.s.i., is also a model of cleanliness.

Yours faithfully,

Smethwick. M. H. CRITCHLEY.

Free-hand Grinding

DEAR SIR,—I have read with great interest not only the articles on constructing drill grinding jigs, but also the comments in your correspondence columns pointing out the ease and simplicity of grinding drills by the free-hand method.

It seems to me, however, that inexperienced workers would do well to start on rather easier work, before attempting to back-off a drill correctly with the lips ground to equal length and to the right point angle.

I would suggest, therefore, that readers should first practise by grinding a regular, straight-sided cone, which has none of these complicated geometrical features.

What, then, could serve better than to try to gain the skill needed for ultimate success by confining the initial attempts to resharpening the lathe tailstock centre by free-hand grinding?

I feel sure that the results obtained in this way will be a revelation.

Yours faithfully,

Bacup. M. T. SHANK.

CLUB ANNOUNCEMENTS

The Acton Model Engineering Society

The club premises at 86A, Churchfield Road, Acton, W.3, will be open on Tuesday evenings only during the summer months. Normal meeting nights, i.e. Tuesdays and Thursdays, will be resumed as from the first week in October.

Hon. Secretary: A. LYON, 18, Midland Lane, Willesden Junction, N.W.10.

The Model Power Boat Association

The 1952 Model Power Boat Association Grand Regatta will be held at Victoria Park, Hackney, London, E., on Sunday, August 31st, commencing at 10.30 a.m.

Events will be in the following order:—

(1) 75 yd. Nomination Race.
(2) 500 yd. race for the E.D. Trophy—"C" (Restricted).
(3) 500 yd. race for the Mears Trophy—"B" Class.
(4) Steering contest for the M.P.B.A. Steering Trophy.
(5) 500 yd. race for the Victory Cup—"C" Class.
(6) 500 yd. race for the Speed Championship Cup—"A" Class.
(7) The Crebbin Trophy for the fastest flash steamer.
(8) Prototype competition for the "M.E." Cup.

For this regatta, all affiliated members of the M.P.B.A. are eligible, but the following conditions will apply.

All entries must be made in advance. Entries will be accepted by post, telephone or may be handed in personally at regattas, etc., but *no entries will be accepted on the day.*

Competitors entering free-running boats should state the time for nomination race. Name of the boat and M.P.B.A. No. should be stated in all cases.

In addition, only one boat per event may be entered by each competitor. In the speed events a special time limit will apply.

Hon. Secretary: J. H. BENSON, 25, St. Johns Road, Sidcup, Kent. Telephone: Foots Cray 7428.

Lymington and District Model and Engineering Society

We are holding our annual model engineering exhibition at the Community Centre, New Street, Lymington, from Wednesday, August 27th until Saturday, the 30th. Open 2 p.m. until 9 p.m. Wednesday, Thursday and Friday, Saturday 11 a.m. until 9 p.m. The club passenger-carrying railway will run on Thursday and Friday evenings and all day on Saturday.

Hon. Secretary: T. G. CRABBE, "Hurst Cottage," Wainsford Road, Pennington, Lymington.

The Isle of Wight Model Engineering Society

This society will be holding its annual exhibition at the Vectis Hall, Ryde, I.W., from Saturday, August 23rd to August 30th. We will be pleased to welcome all model engineers who may be on holiday in our garden isle during that period, and also any models or bits and pieces they might care to bring along. The hall is quite close to the front and the Esplanade Station.

Our portable track and locomotives have now started the season, operating in various parts of the island and will be on active service at the exhibition along with other interesting features. Particulars of the exhibition may be obtained from the Hon. Secretary: V. C. RICHARDS, "Pan Y Lan," Park Road, Wootton, I.W.

Perranporth and District Model Engineering Society

The above society are holding their annual exhibition in the Market Hall, Redruth, on August 30th, to September 6th, both dates inclusive. Further particulars may be obtained from the Exhibition Secretary, F. HARVEY, "Veronica," Perranporth.

Hon. Secretary: W. J. BAKER, St. Pirans Road, Perranporth. Telephone 3243.